

SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MAY 1906.

GENERAL PHYSICS.

836. *Influence of Compressibility on the Formation of Drops.* H. Ollivier. (Comptes Rendus, 142. pp. 836-838, April 2, 1906.)—Experimenting with a small chamber of thick nickel (with a fine orifice, of less than 0.8 mm. diam., waxed so as not to be wetted) connected to the fine stopcock of a reservoir of filtered water kept at constant level, the author finds that, if the connection to the stopcock is a rigid tube, and if the chamber contains no elastic body such as an air-bubble, then on the fall of one drop the next drop immediately shows itself; if, however, the connection is by an elastic tube or there is an elastic body enclosed, a time θ_1 elapses between the fall of one drop and the appearance of the next, which grows for a time θ_2 before it falls. In a given case θ_1 was proportional to the volume of the air-bubble which was not larger than $\frac{1}{2}$ c.cm., while θ_1 diminished and $\theta_1 + \theta_2$ increased as the bubble increased. An explanation of this phenomenon is given, and it is shown that the same intervals θ_1 and θ_2 occur whether the chamber contains air or is connected to a mass of liquid, provided that both undergo the same change of volume for the change of pressure that occurs during the formation of a drop. The method might thus be used to determine the compressibility of a liquid, or indeed of a solid enclosed in the liquid. R. E. B.

837. *Overstraining of Iron by Tension and Compression.* J. Muir. (Roy. Soc., Proc. Ser. A. 77. pp. 277-289, March 29, 1906.)—From the author's experiments it appears probable, first, that if a bar of mild steel be overstrained in compression, and then heated for a few minutes at 100° C., its range of elasticity in compression is increased by an amount roughly equal to that occurring in the corresponding case of tensile overstrain (Roy, Soc., Phil. Trans. A, 1899); and, second, that if a piece be overstrained in tension, and then has its tensile yield-point raised by warming the specimen to 100° C., its elastic range in compression will also be increased by an amount roughly equal to the increase of the tensile elastic range. The following figures are typical: The material had initially a tensile yield-point at 18 tons per sq. in., and an initial compression yield-point at 19 tons per sq. in.; a bar was overstrained in tension to 80 tons per sq. in., and after heating at 100° C. for a few minutes its condition was such that its tension yield-point was at 84 tons per sq. in., and its compression yield-point at 28 tons per sq. in. F. R.

838. *Determination of the Viscosity of Gases.* G. Zemplén. (Ann. d. Physik, 19. 4. pp. 788-806, March 27, 1906. Paper read before the Hungarian Academy of Science, Oct. 23, 1905. From "Mathem.-Naturwissensch. Ber. aus Ungarn," 23. p. 202, 1905.)—The method here employed is to suspend one spherical shell concentrically within another, which is fixed, and to observe its oscillations. The theory of the method is worked out mathematically, and the apparatus used is fully described, as are the arrangements for setting it up properly and for eliminating certain non-determinable magnitudes. For air that is dry and without CO_2 and is at 20.4° and under atmospheric pressure, the author finds $\eta = 0.0001794$ with a maximum error of 1 per cent. R. E. B.

839. *Decay of Torsional Stress in Solutions of Gelatine.* A. O. Rankine (Phil. Mag. 11. pp. 447-455, April, 1906.)—The author has studied the decay of torsional stress in solutions of gelatine of varying concentrations, in which the elastic and viscous properties also varied. He finds that any specimen the concentration of which exceeds some fixed limit, is capable of permanently supporting a certain stress. The nature of the variation of stress for constant strain depends on the amount by which the limiting stress is exceeded. In the case of specimens of greater concentration, in which the elastic properties predominate, the variation of stress under constant strain follows the logarithmic law $W = W_0 - a \log(pt + 1)$ as in the case of lead; but not so in the case of solutions of low concentration. A. F.

840. *Gaseous Osmosis across a Colloidal Membrane.* J. Amar. (Comptes Rendus, 142. pp. 779-781, March 26, 1906.)—Carbonic acid gas was led to the interior surface and air to the outer surface of a pig's bladder enclosed under a bell-jar. The diffused CO_2 was drawn off with the air and measured, 20, 16, 12, and 8 mgm. of CO_2 being collected on successive days for a half-hour period of diffusion. Further, when a small vessel of sulphuric acid was placed under the bell-jar, the amount of CO_2 collected diminished in a fortnight to zero. Hence, it is concluded that a colloidal membrane when perfectly dry is impermeable to CO_2 in contact with its inner surface. G. E. A.

841. *Effect of Pressure on Surface Tension.* C. J. Lynde. (Phys. Rev. 22. pp. 181-191, March, 1906.)—The capillary-tube method is employed, the denser of the two liquids, the surface tension for the surface of separation of which it is required to measure, being placed in a U-tube having a wide limb and a capillary limb. The tube is wholly immersed in the liquid of less density, and the difference of level in the two limbs is observed. On then subjecting the whole to pressure, and observing the change in level in the capillary limb, the coefficient of change of surface tension with pressure ($1/T \cdot \partial t / \partial p$) can be found. A correction must be made for the alteration of level of the liquid in the wide tube. The coefficients are expressed as percentage changes ($100/T \cdot \partial t / \partial p$), and it is found that this is in all cases proportional to the pressure and is independent of the size of the capillary tube. The pressures range from 1,000 to 8,000 lbs. per sq. in. For mercury and water the surface tension increases with pressure; percentage change at pressure 5,000 is 0.74 (mean of two sets of observations); for mercury and ether (increase) the value is 1.28 at 5,000; water and ether (decrease), value is -20.78 at 5,000; chloroform and water (decrease), value is -0.73 at 5,000; carbon bisulphide and water (increase), value is 2.37 at 4,000. S. G. S.

842. Black and Grey Soap Films. H. Stansfield. (Roy. Soc., Proc. Ser. A, 77, pp. 814-828, March 29, 1906.)—Between the coloured and thicker black parts of a soap film Reinold and Rücker noticed the occurrence of a grey colour; the author has found that, with a solution of sodium oleate in water, films can readily be produced which exhibit grey patches, and although he has only observed three grey stages during the thinning process of the films, he has counted as many as six stages in the grey patterns of the films. He has further found that no differences in the behaviour of the films were produced by variation of the temperature, at least between 10° and 85° C. He has succeeded also in photographing the films in different stages, and thus been enabled to give them extended study. Certain brown specks that form in the thinner black and certain lens-shaped thickenings are ascribed to a much larger proportion of soap than in the original soap solution—the result of evaporation. R. E. B.

843. Curvatures of Terrestrial Geoid in Simplon Tunnel. M. Brillouin. (Comptes Rendus, 142, pp. 918-918, April 9, 1906.)—Employing the special form of balance adopted for rapid measurement by Eötvös, 88 cm. long and weighing 200 gm., supported by a torsion ribbon of platino-iridium 85 cm. long, 0.4 mm. wide, and about 0.025 mm. thick, the time of oscillation was adjusted to 559 sec. To the balance is fixed the double refracting spar for recording small changes of deviation [see Abstract No. 515 (1904)]. The half wave-length plate and the second nicol are fixed near the base of a hollow metallic pillar containing the torsion thread. The pillar rests on layers of wadding and felt, to avoid vibration as much as possible. Constancy of temperature is obtained by a triple metallic cover. Observations of the deviation were made in 5 azimuths at intervals of 45° , the last serving as control. One division, about $0.98''$, corresponded to a difference of curvatures of 1.25×10^{-11} (c.g.s.). The survey was carried out during a cessation of work in the tunnel for 5 days, the length of the tunnel being determined by an *invar* tape. The author finds that the ellipticity of the geoid exceeds by 50 or 100 times that of the ellipsoid; it is very variable in size and direction in the interior of the tunnel, and very different from its value outside. C. P. B.

844. Aerial Exploration in the Trade Wind Region. A. L. Rotch and L. Teisserenc de Bort. (Comptes Rendus, 142, pp. 918-921, April 9, 1906.)—In previous notes [Abstracts Nos. 22 and 258 (1906)] the results have been described of measurements taken at various heights in the trade-wind region. The present note is supplementary, and records results obtained by means of balloons and kites between Boston and the Azores. New observations are to be made also near the Canaries. The results show great differences on the two sides of the barometric maximum; on the west side, with SW. winds, the decrease of temperature in the lower layers is much less than on the east side, about 0.80° for 100 m. on the west and 0.80° for 100 m. on the east, at a height of 800 m. At 1,000 m. the difference is less noticeable. The small clouds formed in the region north of the trades appear to be due to water vapour elevated by slow diffusion. The form of these is always characteristic, as are also the flat cumuli of anticyclones. The study of the daily ocean isobars shows that the pressure is not distributed in uniform bands, and it appears that there are regions where the counter-trades are more regular than others. C. P. B.

846. *Chemistry of Sea-water.* T. Schloesing. (Comptes Rendus, 142. pp. 820-824, Feb. 6, 1906.)—The author has taken examples of sea-water on the coast near Tunis and in the middle of the Mediterranean, between Bizerta and Marseille, and further at Dieppe, in the British Channel, which he supposes practically to contain water of the Atlantic. The water near Tunis closely resembles in its composition that taken near Certe by Uriglio except as regards potassium and bromine. The average density of the Mediterranean water is 1.0286, that of the Channel water 1.0289. One litre of water contains, at 20° C., 48.618 and 88.444 gm. of salt respectively. The ratio of the salt contents is about 0.88, and this is approximately also the ratio for the sulphuric acid, chlorine, bromine, soda, &c.; only the alkalinity ratio deviates notably, 0.78. The author concludes that the water of the Mediterranean—a big inland basin—differs but little from that of the oceans in its composition and in the proportion of its constituents; analyses of water from the Eastern Mediterranean would, however, be desirable. H. B.

848. *Primeval Terrestrial Atmosphere.* R. H. McKee. (Science, 23. pp. 271-274, Feb. 16, 1906.)—Referring to the results obtained by Kraft in 1908 and 1905 with regard to the evaporation coefficients of metals *in vacuo* at low temperatures, and also the boiling-points of metals *in vacuo*, it was found that the same rise of temperature is required to overcome the force of gravity at the earth's surface as to overcome the atmospheric pressure, and from this the conclusion was drawn that gravity and the atmospheric pressure are equivalent. Kraft's experimental data are given and discussed. Taking the differences between the temperatures of the beginning of evaporation and boiling in a vacuum, and between boiling in a vacuum and boiling at atmospheric pressure, it is seen that, whether a metal of high or low boiling-point is selected, the two differences are for any given element nearly the same. The chief metals investigated are Hg, Cd, Zn, K, Na, Bi, and Ag. The present writer then attempts to connect these facts to the theory of world-formation. Presuming that the present atmosphere is as great as the force of gravity can control, it is noted that the force of gravity in past times was in all probability less than at present. As on this idea the primeval atmosphere would have to be less, in opposition to the views of Laplace, and other later workers, the alternative theory of Chamberlin and Moulton is invoked to give an explanation, supposing the atmosphere to have been recruited from time to time by the great number of meteoric bodies or particles which fall on the earth, bringing small quantities of occluded gases with them. C. P. B.

847. *Propagation of Earthquake Waves within the Earth.* H. Benndorf. (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1407-1430, Nov., 1905. From the Phys. Inst. d. Univ. Graz.)—For epicentral distances Δ , which are greater than a megametre (*i.e.*, 1,000 km.), the time of arrival T_1 of the first earthquake wave, the vibrations in which are longitudinal, is found, from a discussion of many observations, to be given by $T_1 = 0.4 + 1.7\Delta - 0.042\Delta^2$, times being measured in minutes and distances in megametres. Similarly, the time of arrival of the second wave, that of transversal vibrations, is found to be given by $T_2 = 1.8 + 8\Delta - 0.075\Delta^2$. Both of these times are maximum for $\Delta = 20$. Láska's rule, $T_2 - T_1 - 1 = \Delta$, is found to hold with very tolerable approximation for values of Δ up to 11, and his rule $T - T_2 = 8\Delta$, where T is practically the time of cessation of the shock, is also extremely correct. R. E. B.

848. *Mathematical Interpretation of Seismograms.* V. Monti. (Accad. Lincei, Atti, 15. pp. 217-219, Feb. 18, 1906.)—In order to interpret the seismograms which are necessary to determine completely the motion of the ground in a seismic disturbance [see Abstract No. 668 (1906)], it is necessary to obtain the curve $f(t)$ for each seismogram. The derivatives $f'(t)$ and $f''(t)$ are required, and in order to determine them $f(t)$ must be accurately known. The author describes a method of determining $f(t)$ by examining the actual seismograms by means of a microscope. S. G. S.

849. *Direction of Earthquake Motion.* S. Kusakabe. (Physico-Mathematical Soc., Tokyo, Proc. 3. 1. pp. 10-16, 1906.)—According to Omori, the direction of motion points, for motions of large amplitude, in the majority of cases towards or from the origin of disturbance. Taking Omori's figures, the author shows that the angles between the two directions vary very much, e.g., 54° , 72° , 7° , 57° , 28° , and that the mean angle, 43° , is very nearly 45° , as it should be if there were no preference for any direction. Further diagrams [see Abstracts Nos. 669, 670 (1906)] are then given to indicate that the danger zones and direction of motion are influenced by the geological character of the district. At Miyako there are no records of seismic waves from SE., although earthquakes have frequently taken place in that quarter, probably because there is a long inlet of the Pacific south of Miyako, which seems to force the seismic waves to travel round, so that records of waves from SW. are produced. At Tokyo the E.-W. motion may predominate for similar reasons, but in many cases the origin was lying east of Tokyo. H. B.

850. *Damped Progressive Waves.* H. Nagaoka. (Physico-Mathematical Soc., Tokyo, Proc. 3. 1. pp. 17-25, 1906.)—This is a mathematical discussion of the partial differential equation—

$$\partial^2 U / \partial x^2 = \partial^2 U / \partial t^2 + 2\beta \partial U / \partial t + \gamma^2 U,$$

especially with reference to the tail which characterises the damped progressive wave when $k \equiv \sqrt{(\beta^2 - \gamma^2)}$ is not zero; and it appears that increase of k , while prolonging the disturbance, diminishes the length of the tail. The results are applied to explain the prolongation (due to viscosity) of sound at places far from the source and also the formation of the tail for distant earthquakes. R. E. B.

851. *Theory of Milky Way and Magellanic Clouds.* A. R. Hinks. (Cambridge Phil. Soc., Proc. 13. pp. 201-203, Jan. 31, 1906.)—No determinations of proper motion are yet available for stars fainter than the $9\frac{1}{2}$ magnitude. Stars having appreciable proper motion are almost uniformly distributed over the sky, and may, perhaps, be regarded as forming a star-cloud of which the sun is a member. The author suggests that these facts of star distribution are consistent with the hypothesis that the stars are distributed in a series of more or less independent clouds roughly in one plane. The cloud in which our sun is situated would then supply the stars of sensible proper motion which are uniformly distributed; the neighbouring clouds would supply the bulk of the stars down to the eleventh magnitude, which are to a considerable extent distributed about centres in the galactic plane; the more distant star-clouds would make the Milky Way proper as seen by the unaided eye. The smaller magellanic cloud would on this hypothesis be one of the distant star-

clouds that happened to lie far out of the general plane, while the greater magellanic cloud would have to be classed as a *nebula and star-cluster cloud*. Many of the nebulae now known lie out of the galactic plane, and this may represent the true formation. It is suggested that much information may be obscured by presenting the facts in tabular form, and that charts showing the distribution would be more correct. C. P. B.

852. *Determination of Stellar Radial Velocities.* G. C. COMSTOCK. (Astrophys. Journ. 28. pp. 148-151, March, 1906.)—The author describes a method for determining radial velocities by the objective-prism method, involving a specially constructed double prism, with the refracting angles inverted so as to give two overlapping and crossed spectra. By measuring the distance apart of known spectrum lines in the spectra of the stars whose velocities are required and comparing these measures with the distance between similar lines on a standard star, a determination of the velocity in the line of sight can be obtained. C. P. B.

853. *Results of American Eclipse Expedition, August 30, 1905.* C. M. CHESTER. (Astrophys. Journ. 28. pp. 128-148, March, 1906.)—The U.S. Naval Observatory Expedition established three principal stations for the observation of the solar eclipse—at Daroca and Porta Coeli in Spain, and at Guelma in Algeria. Provision was made for photographing the corona with long and short focus cameras, and for spectroscopic photography of the sun's surroundings. Thirty-six coronal pictures were obtained at the three stations. Excellent spectrum photographs were obtained with a parabolic grating, 4 in. long with 14,438 lines to the inch, and having a focal length of 5 ft. The flash spectrum extends from D_3 to $\lambda 8300$, and shows a very great number of lines. On one of the 6-in. grating spectra the green coronal ring shows most interesting details, at least 15 or 20 small streamers being visible for some distance from the moon's limb. A noteworthy feature is the presence of a nearly radial dark streamer with bright ones on either side, starting from the moon's limb at about latitude 55° or 60° on the sun's east limb. This peculiar streamer is also shown on the 15-ft. camera pictures. The Fraunhofer dark crescents, as seen visually with the spectroscope, became visible about 7 min. before second contact, and D_3 and the hydrogen lines became bright about $1\frac{1}{2}$ or 2 min. before. The green magnesium lines lasted until nearly mid-totality. Polariscopic observations were only made at Guelma, and very satisfactory results were obtained. Inside of $5'$ of arc there is practically no light polarised radially, showing the luminous matter to be in all probability solid or liquid, as evidenced by the continuous spectrum. Between $5'$ and $10'$ of arc the amount of polarised light increases very rapidly, showing that the light is chiefly reflected sunlight. C. P. B.

854. *Parallax of the Nebulae.* J. C. KAPTEYN. (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 726-734, March 7, 1906. Proc. 8. pp. 691-699, March 22, 1906.)—There is scarcely any definite knowledge of the distance of the nebulae at the present time, as on the whole they do not allow of the most accurate measurements, so that direct observations of parallax are not encouraging. Thinking that an investigation of their proper motions might be better, the author has examined the observations of nebulae made by Mönnichmeyer at Bonn. For convenience and increased accuracy of com-

putation the whole proper motion is not used, but only that component of it directed *towards* the antapex. The analytical method of reduction adopted assumes that the sum of the projections on some determined direction of the *peculiar* proper motion vanishes in the case of very numerous nebulae. Of the 208 nebulae available for the discussion, 168 were finally selected after examination of the data of observation. The mean parallax of these 168 nebulae is $0.0046'' \pm 0.0012''$. It is interesting to note that this value is very near to that adopted for the mean parallax of stars of the tenth magnitude. The fact that for observations extending over only about thirty years such reliable results have followed, appears to suggest the desirability of taking up the work photographically, which would render possible the measurement of a much greater number of objects.

C. P. B.

855. *Luminous Particles in Solar Chromosphere and Prominences.* H. Deslandres. (Comptes Rendus, 142. pp. 741-746, March 26, 1906.)—Special search has been made in various eclipse photographs for evidence of continuous radiation in the spectra of the solar chromosphere and prominences, which, if found, would indicate the presence of luminous particles of solid or incandescent material. The problem is rendered difficult by reason of the superposition of the continuous spectrum of the corona. We know that the effect of small particles in the terrestrial atmosphere is very considerable, and it would appear possible that such types of matter may be largely operative in influencing solar absorption and variations of the solar radiation. Photographs taken during the eclipse of May, 1900, showed evidence of continuous radiation in one of the chief prominences, and in August, 1905, the author was enabled to confirm this with more efficient apparatus. Photographs of the eclipsed sun were taken with a camera having specially-prepared colour screens designed to stop all the isolated lines due to the prominences, so that if a prominence was shown on the plate it would have been produced by that part of the continuous spectrum passed by the screen. Thus the prominences on the north-east limb showed continuous spectrum stronger than the neighbouring corona and were of different heights as obtained with and without the screen. [See Abstract No. 70 (1906).]

C. P. B.

REFERENCES.

856. *Report of the Phonogramm-Archivs-Kommission: Preparation of the Archive Records.* F. Hauser. (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 905-908, July, 1905.)—A description of the method adopted for obtaining metallic (electrotype) copies from the original records. For the reproducing point, in place of sapphire, the best results are obtained by the use of one of the end joints of the walking legs of the large sea-spider (*Maja squinado*); such points are exclusively used now.

L. H. W.

857. *Elastic Equilibrium of the Ellipse.* O. Tedone. (Accad. Sci. Torino, Atti, 41. 1. pp. 86-101, 1905-1906.)—The problem of the equilibrium of a cylindrical solid of elliptical cross-section is treated analytically.

S. G. S.

858. *Determination of the Elements of the Path of a Projectile.* F. Neesen. (Deutsch. Phys. Gesell., Verh. 8. 2. pp. 16-18, Jan. 30, 1906.)—The paper describes a continuation of previous work by the author. [See Abstract No. 694 (1903).] The method adopted was similar to the original one.

A. W.

859. Application of Fourier's Integral. **L. Orlando.** (Accad. Lincei, Atti, 15. pp. 205-208, Feb. 18, 1906.)—A short mathematical paper on the application of Fourier's Integral in the determination of the internal deformation in a homogeneous isotropic medium from the surface conditions. S. G. S.

860. Retarded Newtonian Potential. **G. Pavanini.** (Accad. Lincei, Atti, 15. pp. 197-204, Feb. 18, 1906.)—The effect of the finite velocity of propagation of gravitation is generally omitted in studying astronomical problems. The author introduces a second term due to this finite velocity into the expression for the Newtonian potential, and then investigates the case of the motion of two masses owing to their mutual attraction when this retardation of potential is allowed for. S. G. S.

861. Some Physical Problems solved by Fredholm's Equation. **É. Picard.** (Comptes Rendus, 142. pp. 861-865, April 9, 1906.)—Fredholm's equation is generalised in the form—

$$\phi(x, y) + \lambda \iiint f(x, y, u, v) \phi(u, v) du dv = \psi(x, y),$$

where f and ψ are given functions and ϕ a function to be determined, λ being a constant and the integration being taken over a given area of the uv plane, and the form of its solution is indicated. This is then applied to the case of the induced magnetisation on a perfectly soft paramagnetic or diamagnetic body with a given surface, and also to a body of given surface that is cooling by radiation. R. E. B.

862. Propagation of Waves in an Isotropic Medium. **C. Somigliana.** (Accad. Sci. Torino, Atti, 41. 1. pp. 60-71, 1905-1906.)—By means of a partial differential equation of the 4th order in the variables r (distance) and t (time), the author is able to construct functions analogous to the ordinary Newtonian potential, and to a retarded potential, which give a solution of the proposed problem. S. G. S.

863. Acceleration of Plane Waves of Shock. **Jouguet.** (Comptes Rendus, 142. pp. 831-833, April 2, 1906.)—It is shown that $d\rho/dt$, $d\rho/dt$, du/dt have the same sign as $\partial\rho/\partial t$, where ρ , p , u are the density, pressure, and velocity in the front of a plane wave of shock; the wave is thus accelerated or retarded according as $\partial\rho/\partial t$ is positive or negative. R. E. B.

864. Range of Stokes's Deep-water Waves. **R. F. Gwyther.** (Phil. Mag. 11. pp. 374-378, March, 1906.)—An analysis of the range of the waves of finite amplitude discussed by Stokes in his paper on Theory of Oscillatory Waves (Math. and Phys. Papers, vol. i. p. 197, and Supplement, p. 314). J. W. P.

865. Propagation of Waves from a Centre in an Elastic Medium. **J. Bousinesq.** (Comptes Rendus, 142. pp. 542-545, March 5, and pp. 609-612, March 12, 1906.)—The wave in a homogeneous isotropic medium is here investigated which starts from a centre and is propagated without change of density; it is found to be of the same thickness as that propagated without rotation and, like it, to be preceded by a head of indefinite length in which the displacements are continuously equal and contrary to those in itself at the same points of space, the movements in the wave being further transversal. In the second paper the character of the total wave at the points where the wave of longitudinal vibrations and that with transversal vibrations overlap is discussed. [See Abstract No. 657 (1906).] R. E. B.

866. The Corpuscular Theory of Matter. **J. J. Thomson.** (Engineering, 81. pp. 317-318, March 9; 349-350, March 16; 389-390, March 23; 420-421, March 30; 454-455, April 6, and pp. 490-491, April 13, 1906. From Lectures delivered before the Royal Institution. Ecl. Electr. 47. pp. 220-222, May 12, 1906.)

867. *Diffusion of Gases.* **J. Nabl.** (Phys. Zeitschr. 7. pp. 240-241, April 1, 1906.)—It is shown that Langevin's expression for the diffusion-coefficient of one gas into another [see Abstract No. 503 (1905)] on the assumption that the molecules behave as elastic spheres is deducible from Stefan's if with the latter Maxwell's velocity-distribution is assumed and but little diffusion has occurred. **R. E. B.**

868. *Air Transparency under varying Weather Conditions.* **M. Samec.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1519-1568, Nov., 1905.)—Measurements of atmospheric transparency, as determined from varying distances at which objects are clearly visible, tabulated with reference to the barometric pressure and temperature. **C. P. B.**

869. *Comet Brooks, 1906 (a).* (Nature, 73. p. 326, Feb. 1, 1906.)—Discovery announced from Kiel of new comet in Herculis, travelling towards Draco. **M. Ebell.** (Astron. Nachr. No. 4075, Nature, 73. p. 400, Feb. 22, 1906.)—Daily ephemeris. Brightness diminishing. **E. Millosevich.** (Accad. Lincei, Atti, 15. p. 147, Feb. 4, 1906.)—Observations made at Rome. (Kiel Centralstelle Circular No. 85. Nature, 73. p. 352, Feb. 8, 1906.)—Elements and short ephemeris. **Rambaud and Sy.** (Comptes Rendus, 142. p. 382, Feb. 12, 1906.)—Observations made with the equatorial Coudé at Algiers. On Jan. 31 the comet is described as a round nebulousity with an excentric nucleus; diam. about 1' of arc, and about the eleventh magnitude. **E. Esclangon.** (Comptes Rendus, 142. p. 498, Feb. 26, 1906.)—Observations at Bordeaux. **C. P. B.**

870. *Comet, 1906 b.* (Nature, 73. p. 494, March 22, 1906. From Astronomische Nachrichten, No. 4078.)—Observations by Hartwig at Bamberg, Wirtz at Strassburg, and Max Wolf at Heidelberg. The comet had a diam. of about 10", and a central condensation of about the eleventh magnitude. It had a tail about half a degree in length, extended to the north-west on March 4. **C. P. B.**

871. *Comet Ross, 1906 c.* (Nature, 73. p. 494, March 22, 1906. Announced by telegrams from Kiel.)—Positions of new comet discovered by Ross at Melbourne on March 18, 1906. **Strömgren.** (Kiel Circular, No. 87. Nature, 73. p. 518, March 29, 1906.)—Elements and ephemeris computed from the observations on March 19, 20, 21. **C. P. B.**

872. *Path of the Meteor of March 14, 1905.* **G. v. Niessl.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1477-1518, Nov., 1905.)

873. *Standard Velocity Stars.* **V. M. Slipher.** (Astrophys. Journ. 22. pp. 313-340, Dec., 1905.)—A summary of the observations and tables of individual measures of standard velocity stars during the summer and autumn of 1905. The spectra of titanium, chromium, iron, and vanadium were employed for comparison, and special precautions taken against extreme variations of temperature in the prism box, this being usually not more than 0.1° C., even for the longest exposures. [See Abstracts Nos. 2574, 8183 (1904), 2038 (1905).] **C. P. B.**

874. *Orbit and Periodic Motion of Comet Holmes.* **H. J. Zwiers.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 674-685, Feb. 7, 1906. Proc. 8. pp. 642-653, Feb. 21, 1906.)—Discussion of available observations, determination of definitive orbit, and computed ephemeris for coming apparition in May, 1906. **C. P. B.**

875. *Total Solar Eclipse, January 13-14, 1907.* **D. Todd and R. H. Baker.** (Amer. Journ. Sci. 21. pp. 245-246, March, 1906. Contribution from Amherst Coll. Observatory, 73.)—From computations based on the Besselian elements of the American Ephemeris, a list of eleven possible stations in Turkestan or Mongolia is given with the chief elements of the eclipse at each. **C. P. B.**

LIGHT.

876. *New Form of Spectroheliograph.* G. Millochau and M. Stéfaniik. (Comptes Rendus, 142. pp. 825-826, April 2, 1906.)—In the hope of reducing the errors due to friction, &c., in the ordinary pattern of spectroheliograph, the authors have mounted the spectroscopic portion so as to be movable on a horizontal axis perpendicular to the plane containing the axes of the collimator and camera lenses. The requisite motion is then produced by a pump placed vertically, the piston of which is connected to the spectro-scope by a pointed rod fitting into conical holes at each end. The axis of rotation should pass through the intersection of the collimator and telescope, and the distances between this axis and the two slits should be in the same ratio as the focal lengths of the objectives. In the case where a grating is employed as the dispersive agent, the second slit may be fixed in the axis of the telescope, and the position of the spectrum adjusted by slightly turning the grating. This secondary slit is widened for a small distance at each of its extremities, so as to obtain, before and after the solar photograph, a portion of the spectrum of the diffuse skylight, and thus more easily determine the exact wave-length of the radiation with which the monochromatic photograph of the sun's surface has been made. The sunlight for such an instrument as proposed may be supplied by a siderostat or cœlostat, or by the instrument being applied directly to an equatorial. In the latter case the mounting should have a motion of rotation round the axis of the objective. C. P. B.

877. *Objectives with Edge Contact.* R. Steinheil. (Zeitschr. Instrumentenk. 26. pp. 84-87, March, 1906.)—Though the practice of cementing together the two components of an achromatic telescope objective is known to have a bad effect on the definition, it has been continued in the case of small objectives because, when the inner surfaces are exposed to the air, deposits are liable to form, which cannot be easily cleaned as in the case of the outer surfaces. With the usual construction, the hollow lens enclosed between the crown and flint lenses is concave, so that the glasses are in contact at their centres. In uncemented objectives, a piece of tin-foil has generally to be inserted between the glasses at their edges, in order to prevent alteration of curvature from central pressure. A very slight displacement of this foil has usually a very injurious effect on the definition, so that the lenses cannot be taken apart and replaced without great inconvenience. The author's remedy is to make the enclosed air lens convex instead of concave. He has found a large number of glasses which enable this to be done without sacrificing any of the usual four conditions of good definition (including the sine condition), and he has calculated tables to guide selection. A. E.

878. *Thermodynamics of the Electric Incandescent Lamp.* E. F. Roerber. (Amer. Electrochem. Soc., Trans. 8. pp. 243-259; Discussion, pp. 259-267, 1905. Electrician, 56. pp. 70-78, Oct. 27, 1905. Elect. Rev., N.Y. 47. pp. 546-548, Oct. 7, 1905. Écl. Électr. 45. pp. 278-280, Nov. 18, 1905.

Abstracts.)—The total radiation from the filament of a glow-lamp consists of electromagnetic waves of an infinite series of different wave-lengths. The physiological effect of light is produced on the normal eye by waves the lengths λ of which lie between 0.8μ and 0.4μ . Hence the filaments that radiate most of their energy by waves whose lengths lie between the given limits will be the most efficient. Now we know by Wien's law that if T be the absolute temperature of the filament and λ_m is the length of the wave that radiates the maximum energy, we have $\lambda_m T = \text{const.}$ For a black body this constant is 0.294 if λ_m be expressed in cm. By another law due to Wien and modified by Planck we get a relation between the energy radiated, the wave-length, and the absolute temperature for a black radiating body, which is stated to represent with great accuracy the physical law. It is calculated by Wien's law that, in order to get λ_m near the sodium line, the temperature of the filament would need to be $4,600^\circ \text{C.}$ As this is far beyond anything we can reach with glow-lamps no attempt is made to calculate by Planck's law the temperature at which the energy within the visible spectrum is a maximum. In practice the efficiency of a lamp is given as the c.p. produced by 1 watt and not as the ratio of the energy of radiation within the visible spectrum to the total radiation. It is sometimes assumed that the energy of the c.p. is proportional to the light emitted, but this can only be true for monochromatic light. The results obtained therefore for the mechanical equivalent of light are very doubtful unless monochromatic light has been used. Tummlirz obtains 0.188 watt per spherical Hefner c.p. As water was used to absorb the invisible spectrum this result is too high. Ångström found 0.102 watt. Assuming 1 spherical Hefner to equal 0.88 spherical candle, this gives 8.68 spherical c.p. per watt as the maximum possible efficiency. Now recent tests of a tantalum lamp gave an average value of 0.37 m.s.c.p. per watt, and thus, on Ångström's equivalent, its efficiency is 4.8 per cent. An ordinary glow-lamp would have an efficiency of less than 3 per cent. It is pointed out that the reduction factor of a glow-lamp, namely, the ratio of the mean spherical to the mean horizontal c.p., so far from being a constant for given types of lamps actually varies considerably during the life of a given lamp. The distribution of the light in a vertical plane changes considerably during the life. When the filaments have not the characteristics of a black body the theoretical equations are only known approximately. According to Kirchhoff's law the ideal filament must be one which only absorbs rays within the visible spectrum, while it either perfectly reflects or is perfectly transparent to all other rays. Polished platinum will have λ_m nearer the visible spectrum than a black body, but it is far from being the ideal material. The ideal filament must have a polished surface without pores.

A. R.

1879. *Cooper-Hewitt Lamp as Source of Monochromatic Light.* C. Fabry and H. Buisson. (Comptes Rendus, 142, pp. 784-785, March 26, 1906.)—The light from this lamp is steady and of uniform intrinsic brightness, and the yellow and green rays are fine enough to give interference effects with a path difference of 22 cm. , i.e., of the order $400,000$. This limit is constant for the lamp and does not fall with time as in the older Perot-Fabry model, and, as the lamp is now a commercial product, acts indefinitely without attention, and consumes little energy, it forms a very advantageous source of light, although the satellites accompanying the four intense rays of its visible spectrum prevent these rays from being used as fundamental standards in spectroscopy.

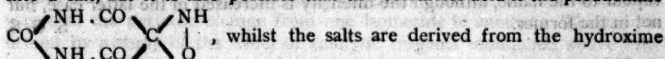
G. E. A.

880. *Colour Sensitiveness of Photographic Plates.* C. E. K. Mees and S. E. Sheppard. (Photographic Journ. 46. pp. 110-180; Discussion, pp. 180-181, March, 1906.)—The first part of the paper describes the method of obtaining spectrum curves. Photographs were taken on panchromatic plates in the Tallent spectroscope, the screen in front of the acetylene burner being altered until the screened acetylene gave the same curve as daylight. The constituents of the screen in its final form are: A, 1 cm. thick, gentian violet 2/100,000, acid green 1/100,000, mandarin orange 1/100,000, rose bengal 4/1,000,000; B, 1 cm. thick, copper acetate solution 1½ per cent. The B filter is required for cutting down the red to the proper proportions. The other two parts into which the paper is divided deal respectively with the methods of using broad-banded filters; and the possibility of combining these two systems into a general system of spectrosensitometry. [See also Abstract No. 526 (1905).] G. E. A.

881. *Variation in some Properties of Quartz.* H. Buisson. (Comptes Rendus, 142. pp. 881-883, April 9, 1906.)—Examination of two perfectly limpid specimens of quartz, apparently without defect, of cubical form with edges 4 and 5 cm. long respectively, shows certain systematic differences between them, the larger having the smaller density and refractive, bi-refractive and rotatory powers; the differences are very small, but they are marked. Is quartz, then, even though well crystallised, a perfectly defined body? R. E. B.

882. *Entoptic Vision.* W. F. Barrett. (Roy. Dublin Soc., Proc. 11. 7. pp. 48-61, March, 1906.)—If a divergent pencil of rays from a point of light near the eye be allowed to enter the eye, the shadows of entoptic objects become sharper, owing to the absence of penumbra, and under such conditions any one can make a self-examination of any small opacities that may exist within the field of vision in either of his eyes. By this means the author discovered for himself the presence of incipient cataract in both his crystalline lenses. As the anterior principal focus of the eye may be taken as 14 mm. distant from the cornea, when an illuminated pin-hole is placed at this distance the rays of the divergent cone of rays entering the eye are rendered parallel, and hence the shadow of any object in or behind the crystalline lens will be practically of the same size as the object, but if the pin-hole be nearer to the eye than the anterior focus the shadows will be larger than the object. The shadow on the retina is erect and therefore is perceived completely inverted, laterally as well as vertically. Assuming that the perception of entoptic objects near the retina, when no stenopaic screen is used, follows the same law of projection as that of external objects—and experiments indicate that this is the case—the linear magnitude x of an obscurity within the eye is to the linear magnitude of the projected image S , as the distances d and D of the nodal point from the retina and from the projected image respectively, or $x = S \cdot d/D$. When a stenopaic screen is used the magnification does not follow the above rule. The path of the projected shadow corresponds to the path of the incident rays crossing at the pin-hole aperture only. Hence the magnification is in the direct ratio of the distance d of the pin-hole from the pupil to its distance D from the illuminated screen S on which the shadow is projected. The distance of entoptic objects from the retina, as Listing has shown, can also be ascertained by noting the relative parallactic displacement of the shadow, which occurs on moving the eye. H. W. P. Y.

883. *Absorption Spectra of Uric Acid, Murexide, and the Ureides in Relation to Colour and Chemical Structure.* W. N. Hartley. (Chem. Soc., Journ. 87, pp. 1796-1922, Dec., 1905).—The simple ureides, such as barbituric acid $\text{CO} \begin{smallmatrix} \text{NH} \cdot \text{CO} \\ \text{NH} \cdot \text{CO} \end{smallmatrix} \text{CH}_2$, and uramil $\text{CO} \begin{smallmatrix} \text{NH} \cdot \text{CO} \\ \text{NH} \cdot \text{CO} \end{smallmatrix} \text{CH} \cdot \text{NH}_2$, show no absorption band in their spectra, and as a rule transmit ultra-violet light freely (compare cyanuric acid, $\text{CO} \begin{smallmatrix} \text{NH} \cdot \text{CO} \\ \text{NH} \cdot \text{CO} \end{smallmatrix} \text{NH}$, and its esters; Brit. Assoc. Report, 1901, Hartley, Dobbie, and Lauder). Similarly pure violuric acid when dissolved in pure water, prepared by allowing pure ice to melt in an aluminium funnel in an exhausted space, gives colourless solutions, but these become coloured in contact with air or with glass. The experiments now described were made in a platinum basin. The author ascribes the development of colour to ionisation of the colourless acid when converted into a salt, but it is also possible that the colourless acid is the pseudoxime



$\text{CO} \begin{smallmatrix} \text{NH} \cdot \text{CO} \\ \text{NH} \cdot \text{CO} \end{smallmatrix} \text{C} : \text{NOH}$. The linking together of two simple ureides by one or more polyvalent atoms causes a powerful selective absorption, which is destroyed when the rings are disunited by hydrolysis or otherwise.

T. M. L.

884. *Isolation and Atomic Characters of Dysprosium.* G. Urbain. (Comptes Rendus, 142, pp. 785-788, March 20, 1906).—The rare earths comprised in the author's fractionations between terbium and yttrium are composed of the constituents of the earth X suspected by Soret (1878) in the yttriferous earths fractionated by Marignac. Clève gave to the earth X the name of holmium, but Lecoq de Boisbaudran separated the latter earth into holmium and dysprosium (1896), the second of these being considered by later writers as complex. The author has separated 50 gm. of an earth which retained the same atomic weight, $\text{Dy} = 162.49$, through fourteen consecutive fractions. This substance has an ultra-violet spectrum composed of intense and diffused bands which overlap certain bands of terbium and holmium so as to entirely mask the latter two substances in mixtures.

G. E. A.

885. *Polarisation of the Light emitted by a Stream of Atom-ions.* J. Stark. (Deutsch. Phys. Gesell., Verh. 8. 8, pp. 104-110, March 30, 1906).—The light emitted by the canal rays in hydrogen is received in a direction at right angles to the path of the rays. On receiving the light upon a nicol prism it is found that with the nicol placed to transmit light with electrical vibrations parallel to the canal rays the transmitted light has a reddish tinge, and when the nicol is rotated through 90° the total intensity is less and the light has a bluish tinge; the effect is very small and precautions must be taken before it can be observed. In a second experiment a spectrum is obtained from the negative glow and from the canal rays in a direction at right angles to their path, the Doppler-effect being thus avoided. Using the H_β and H_γ lines it is found that in the latter case the lines are displaced towards the red and are broadened, both effects being proportional to the square of the velocity of the canal rays. These results are to be expected if, according to W. Voigt [see Abstract No. 785 (1901)], the light-emitting atoms are under the influence of an electrical field, each line becoming a doublet, the com-

ponents being both displaced towards the red. If now the light be received in the direction of translation, the author would expect the line to be displaced towards the red but not dispersed, as the electrical vibrations are in this case all normal to the direction of translation. The same displacement should occur with the light emitted by the positive ions in flames and the electric arc, but here the Doppler-effect is not eliminated. In the case of the arc, the displacement of the lines towards the red when the pressure increases is explained by the author by means of the alteration of period in the vibrating parts of each ion by the electrical field due to neighbouring ions, and not to rise in temperature of the arc. From the charge on the ion and the distance apart of the ions the author shows that this field may be considerable, and with increasing density the effect would be greater. Further, the ions need not be all of the same kind; thus the D lines from a sodium burner are rendered less sharp by the addition of either potassium or sodium vapour to the flame, although the intensity is increased in the latter case, but not in the former.

S. G. S.

886. *Absorption Bands of a Crystal in a Magnetic Field.* J. Becquerel. (Comptes Rendus, 142. pp. 775-779, March 26, 1906.)—The ordinary and extraordinary absorption spectra of xenotime (phosphate of yttria with erbium and rare earths) are examined at the same time by means of light transmitted normally to the magnetic field, comparison being made with the spectrum of iron. Two groups of bands, one in the red and one in the green, were studied in particular. In a magnetic field of about 31,800 c.g.s. units the displacement of several bands is much greater than would be expected from a knowledge of the Zeeman-effect. Also the bands of the ordinary spectrum behave very differently according to the orientation of the axis of the crystal, the direction of the ordinary vibration remaining the same with regard to the magnetic field. The change in the intensity of the components separated is also remarkable, some of these being visible only while the magnetic field is being established.

G. E. A.

887. *Absorption and Sensitising Spectrum of the Cyanins.* A. v. Hübl. (Photographic Journ. 46. pp. 138-137, March, 1906. Translation from Eder's "Jahrbuch f. Photographie und Reproduktionstechnik," 1905.)—All cyanins are distinguished by their capacity for strongly colouring silver chloride or bromide and making them sensitive to the less refrangible rays of the spectrum, the colouring imparted to the silver salt being intimately connected with the spectral zone of sensitiveness. The absorption spectrum of all cyanins is characterised by two bands, α towards the red and β towards the blue, whose maxima lie 400-450 A.U. apart. Solutions in alcohol show an intense α band, whilst in watery solutions the β band is broad and strong. With dry films the bands appear at almost equal intensity, but dyed collodion films always show an approximation to the "alcohol" spectrum, stained gelatine films partaking more of the type of the "water" spectrum. It is deduced that the aqueous and alcoholic solutions contain the cyanin in different forms, distinguished by their colour, the aqueous solution being redder. The sensitising action of the cyanins corresponds with the absorption spectrum they show when in the dry state; the lowering of the sensitiveness corresponding to the α band appears, however, to be connected with the colouring imparted to the silver bromide. Spectrum curves are given in illustration of the effects described, and a table gives the position of the maxima for solutions of ethyl red, pinaverdol, orthochrom, and pinachrom in

chinoline, alcohol, and water, and for dry gelatine films. Particulars are also given of the behaviour of dicyanin which, with colloidal emulsion at least, surpasses any hitherto known dye in its sensitising action for the most extreme red.

888. *Ultra-violet Absorption Spectra in Relation to Physico-Chemical Processes.* E. C. C. Baly and C. H. Desch. (Astrophys. Journ. 28, pp. 110-127, March, 1906.)—Using a modified Hartley method, the authors have investigated the ultra-violet absorption spectra of acetyl acetone and ethyl acetoacetate and their respective metallic derivatives; they have also studied the effect of the presence of hydrochloric acid and of sodium hydroxide in modifying the spectra. Neither the pure ketonic nor the pure enolic modification gives an absorption band in the ultra violet. An absorption band is obtained only when both modifications are present in a state of dynamical equilibrium with one another, so that the band must be connected in some way with the periodic change from one isomeride to another. This is confirmed by a study of the effect of catalytic reagents mentioned above; the persistence of the absorption band is increased by the addition of alkali hydroxide and diminished by acid: successive additions of alkali increase the persistence till a maximum value is reached; these results are independent of the ionisation or hydrolysis of the compounds. The production of the absorption band is expounded by the authors in terms of the electron atomic theory.

889. *Spectral Lines in Relation to Ions.* J. Stark. (Deutsch. Phys. Gesell., Verh. 8. 6. pp. 111-115, March 30, 1906. Phys. Zeitschr. 7. pp. 249-251, April 15, 1906. Nature, 73. pp. 533-534, April 5, 1906.)—The author summarises the results of measurements of the spectral lines emitted by the canal rays in hydrogen, potassium vapour, and mercury vapour, but details of the measurements are to be given in subsequent papers. In a previous paper [see Abstract No. 297 (1906)] the author has shown that the canal rays in hydrogen exhibit the Doppler-effect, and hence are identified as the emitters of the spectral lines. From the extended series of observations the emitters of the line spectra in the case of all the elements are the positive atom-ions. All the lines of a series have the same source, and the same ion may be the source of several series at the same time. Further, the principal series and subordinate series of doublets are emitted by the monovalent positive ion, and the subordinate series of triplets by the divalent positive atom-ion, while ions of a higher valency also emit line-spectra. An element such as mercury may emit more than one of these spectra at the same time, when the monovalent, divalent, &c., atoms may be present together.

890. *Phosphorescence of some Organic Compounds between +100° and -190°.* P. Borrissov. (Jurn. Russk. Fizik. Chimičesk. Obščestva, Physics Pt. No. 9. pp. 249-246, 1905.)—The author has studied the influence of temperature on the phosphorescence of a number of organic compounds and endeavoured to correlate phosphorescence and fluorescence. He determined experimentally: (a) the intensity and colour of the phosphorescence of about 120 organic compounds at the following temperatures, viz., -190°, -80°, -20°, +20 (approximately) and +100°; (b) the duration of the phosphorescence at the temperatures mentioned; (c) the phosphorescence of solutions of a number of organic compounds in ether, water, alcohol, benzene, and chloroform; (d) the fluorescence of the experimental substances in the solid condition, and partly

also in solutions in water, alcohol, ether, benzene, and chloroform. The experiments on phosphorescence were carried out as follows: The substances were enclosed in thin-walled tubes, and after cooling in a bath of liquid air or otherwise, removed from the cooling bath, exposed for a short time to the action of a Dubosc arc lamp, returned to the bath and finally tested as to their luminosity. The chief results of the investigation may be summarised in the following statements: (1) Phosphorescence at low temperatures is a very common phenomenon amongst organic compounds; only a few organic compounds fail to become luminous at the temperature of liquid air after having been exposed to the light of the voltaic arc. (2) Coloured organic compounds do not phosphoresce at all or they shine very faintly; such are the whole of the nitro compounds, the dyes and other coloured bodies; however, the solutions of some coloured bodies (rosaniline, fluorescein) become luminous, sometimes very distinctly, although these bodies themselves either do not shine at all, or at most very feebly. (3) The phosphorescence of organic bodies has been observed at much higher temperatures than is generally supposed. In the case of many bodies it may be observed at the temperature of -20° and for some even at a temperature of $+100^{\circ}$. For a large number of bodies phosphorescence begins at a temperature of about 50° – 150° below the melting-point. (4) Organic acids, albumen, and some alkaloids are the most phosphorescent bodies studied by the author. (5) The predominant colour of the phosphorescence is green; this predominance is very marked. (6) For exposures exceeding 1 sec. the duration of the phosphorescence at the temperature of liquid air does not depend on the duration of the preliminary illumination. (7) For considerable variations of temperature the duration of the phosphorescence for most of the substances studied (15 out of 26) may be expressed as a linear function of the temperature. Two cases gave doubtful results; in the remaining cases the connection may be expressed by curves similar to hyperbolas, having the axis of temperatures as principal axis. (8) With rising temperature the colour of the phosphorescence approaches white, and assumes a more bluish tint. (9) The intensity and duration of the phosphorescence decrease with rising temperature. (10) Alcoholic and aqueous solutions are more luminous (sometimes much more) than the dissolved bodies themselves. (11) With change of concentration of the solution, the intensity of the phosphorescence does not change much. The duration of the phosphorescence and the colour do not vary perceptibly. (12) The duration of the phosphorescence of solutions in chloroform and in benzene is the same as for these solvents, but for alcoholic, aqueous, and ethereal solutions it varies very decidedly from the duration for the solvents. (13) In the case of several bodies an unequal distribution of the light over the surface of the phosphorescent body was observed. For bodies liquid at the ordinary temperature the light is most intense at the bottom of the tube, at the meniscus and along the cleavage faces of the solidified substance. The phenomenon is much more marked in the case of bodies which remain transparent after freezing than in the case of opaque bodies. Unequal phosphorescence was also observed at times with crystalline powders. The separate points over the surface of the body shine like stars on a dark background.

The fluorescence of the experimental substances was studied: (a) by direct visual observation of the substance while illuminated with a Volta arc lamp; (b) by spectroscopic observation of the fluorescence excited by ultra-violet rays; (c) by the Stokes method; (d) by direct observation of the fluorescence excited by light filtered through violet glass. (14) The colour of the fluores-

cence is different from that of the phosphorescence. (15) The predominant colour of the phosphorescence is blue. (16) In the fluorescence spectra the rays of medium refrangibility (D to F) predominate. (17) In the cases studied by the author (certain alcoholic solutions) the luminous part of the fluorescence spectrum becomes displaced towards the violet end of the spectrum as the temperature decreases. (18) Formic acid, 40 per cent. aqueous solutions of formaldehyde, acetic aldehyde, acetone, phenol, sodium, and potassium tartrates, tartaric acid, oil of orange, dipentene, cocaine, limonene, and certain other bodies, become luminous during a change of temperature, without previous illumination. (19) At low temperatures æsculine and barium platinocyanide retain in a latent form a part of the energy absorbed at the temperature of liquid air and give it up as the temperature rises. (20) Lactic acid, methyl acetate, tartaric acid, aqueous solutions of malic and camphoric acids, and of cocaine hydrobromide, alcoholic solutions of α -bromopropionic acid, become luminous during solidification. D. H. J.

891. *Fluorescence produced by Radio-tellurium.* H. Greinacher. (Phys. Zeitschr. 7. pp. 225-228, April 1, 1906.)—The fluorescence produced in glass and mica by a preparation of radiotellurium was observed in the dark after resting the eye for a considerable time. Since the fluorescence appears on the surface facing the radiotellurium, it is concluded that the α -rays are the cause of it. A discussion of the fluorescence caused by α -rays in other bodies, as observed by others is given. [See Abstracts Nos. 108 (1904) and 108 (1906).] Photographs are taken by laying a sheet of glass, a sheet of mica, or a quartz lens upon a copper sheet on which the preparation of radiotellurium has been deposited, and a photographic plate upon this. The photographs are reproduced and in all cases they indicate a fluorescence produced in the material by the radiotellurium. In the cases of glass and mica, the intensities of the effects are not in the same ratio in the photographic as in the direct-vision experiment, showing that the rays emitted by the glass and mica differ in kind. S. G. S.

892. *Radio-activity of Rain and Surface Waters.* J. Jaufmann. (Meteorolog. Zeitschr. 22. pp. 102-113, March, 1905. Chem. Centralblatt, ii. p. 600, 1905. Abstract.)—To 1 litre of the water to be examined a measured quantity of potassium alum solution is added, and the latter precipitated with ammonia. The radio-activity of the emanation and the induced radio-activity retained in the precipitate, determined with an Elster-Geitel type apparatus, are found to be intermediate between the activity of radium and that of thorium. Rain is always slightly radio-active, especially that falling during a thunderstorm in the spring, or in cities; with continued downpour the activity decreases. Freshly fallen snow is three to five times as active as rain. The activity of both rain and snow decreases after falling, but in the case of snow lying on the ground the activity may increase owing to further absorption. Hailstones are more active than rain. Natural ice is sometimes very strongly radio-active. Surface water is always active, but to a very variable degree, the atmospheric pressure appearing to be influential; in the case of spring waters, the deepest spring is the most active. If the ground is frozen for a lengthened period, the activity increases, and decreases again on a thaw occurring. L. H. W.

893. *Radio-activity of the Uranyl Double Salts.* W. Marckwald. (Ber. Deut. Chem. Gesell. 39. pp. 200-208, 1906. Chem. News, 98. p. 98, VOL. IX. T

March 2, 1906.)—It has been stated that certain uranyl double salts have an abnormally "powerful radio-active effect upon the photographic plate." Experiments showed a normal effect on the electroscope and also on the photographic plate when the latter was shielded with opaque paper; the α - and β -radiations are therefore normal and the additional effect which is noticed on an unprotected photographic plate is probably due to the fact that in the double salts, which are characterised by a strikingly beautiful fluorescence, an exceptionally large part of the Becquerel radiation is converted into light energy. T. M. L.

894. β -Polonium. F. Giesel. (Ber. Deut. Chem. Gesell. 39. pp. 780-782, 1906. Chem. News, 98. pp. 145-146, March 30, 1906.)—The identity of the Curies' polonium, Marckwald's radio-tellurium and the author's polonium has been fully established by a determination of the decay constant—140 days for a decrease to half the initial value. This substance emits only α -radiation, but the author's preparations showed initially a very strong β -radiation, which was absent from the preparations of Marckwald. This β -radiation, which is attributed to a distinct substance, for which the name β -polonium is proposed, has now been examined and has been found to decay to one-half in 6.14 days; this value, unlike that for α -polonium, is not found amongst the time-constants of the radium-derivatives investigated by Rutherford and further experiments are necessary to explain the eventual position of β -polonium in the series of decay products of radium. The constant of decay is 0.1128; the life of the β -polonium atom is thus 8.86 days. T. M. L.

895. Radio-activity of Springs. H. W. Schmidt and K. Kurz. (Phys. Zeitschr. 7. pp. 209-224, April 1, 1906. Phys. Inst. d. Univ., Giessen, Feb. 7, 1906.)—The radio-activity of many of the springs in Hessen and the surrounding country is examined by means of the portable apparatus designed by the authors. From a number of readings, in each case, the conductivity of the air in the dispersion vessel which has immediately before been shaken up with the water under investigation, is determined. From the rate of decay of the conductivity, and therefore of the emanation from the radio-active material contained in the water, the authors determine whether thorium emanation is present with that of radium, and the relative amounts of the two. It is shown how the effect of the rapidly decaying thorium emanation may be separated from that of the slowly decaying radium emanations from a previous knowledge of the curve for the latter. The water from over 100 springs is examined and the sediment from 20, the geological formation of the ground from which the spring emerges being given. From a comparison of the two sets of experiments it is evident that there is no definite relationship existing between the radio-activity of the water and that of the sediment. Springs arising in igneous formations are more radio-active than those in sedimentary deposits, those in chalks and sandstones being the least radio-active. S. G. S.

896. Absorption of γ -rays. A. S. Eve. (Phil. Mag. 11. pp. 586-595, April, 1906.)—The question is investigated whether the γ -rays can be taken as an accurate measure of the total amount of radio-active matter present in a given substance. It is, therefore, necessary to ascertain whether those from different substances are absorbed equally. It is found that the γ -rays from radium, uraninite, thorium, and radio-thorium are absorbed at the same

rate by lead, those from uranium and actinium much more rapidly. It is shown that actinium emits four types of rays. It is suggested that 1 kg. of thorium nitrate, in a thin glass vessel 16 cm. in diam., placed under a layer of lead 1 cm. thick, might be adopted as a convenient standard for measuring the quantity of radium or thorium in ores. R. S. W.

897. Secondary Radiation from Compounds. J. A. McClelland and F. E. Hackett. (Roy. Dublin Soc., Trans. 9. 3. pp. 27-36, April 12, 1906.)—In previous papers [Abstracts Nos. 992 and 1397 (1905) and 530 (1906)] McClelland has studied the secondary radiation of β -particles which is emitted by substances when they are exposed to the β - (and γ -) rays of radium. The intensity of the secondary radiation in the case of the elementary substances examined was found to depend on the atomic weight, increasing with this quantity, and the theory was advanced that the action producing the secondary radiation is entirely an atomic one. It should thus be possible to calculate the intensity of the radiation given by a chemical compound when the radiating power of each of its constituents is known and also the relative amount of each present in the compound. In this paper an account is given of the experimental measurement of the secondary radiation from a number of compounds, the values found being compared with those calculated from the previously obtained values for the constituent elements of the compounds. The calculated and experimental values show very good agreement and thus confirm the theory that the action is an additive atomic property. The apparatus used was the same as that previously described [Abstract No. 530 (1906)]. Whether the emission of the secondary β -rays involves a breaking-up of the atom in the sense in which the term is used in connection with radio-activity is a point that is not decided. The β -particles that are emitted as secondary radiation must, however, actually come from the atoms; if they were free electrons just before emission it is difficult to see how such remarkable relations should exist between the atomic weight and the intensity of the secondary radiation. J. J. S.

REFERENCES.

898. Improvements in the Spectroheliometer. A. Sauve. (Accad. Lincei, Atti, 15. pp. 168-173, Feb. 4, 1906.)—The author points out that he has previously described (Mem. della Soc. degli Spettroscopisti Italiani 33, 1904) an apparatus on the same principle as that of Nodón [see Abstract No. 288 (1906)]; the description is reproduced.

899. Note on Talbot's Lines. J. Walker. (Phil. Mag. 11. pp. 531-534, April, 1906. Communicated by the Physical Society, Feb. 23, 1906.)—A physical explanation is given of the fact that the retarding plate employed in producing Talbot's lines must be inserted on the one side of the aperture rather than on the other. The plate is placed over the right or left half of the aperture according as the dispersion in the focal plane of the telescope from red to blue is from right to left or from left to right. An expression is also found for the best thickness of the retarding plate for a given part of the spectrum. G. E. A.

900. Appearance of Stars. W. Holtz. (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 5. pp. 439-441, 1905.)—Further notes, with illustrations, on the subject of a previous paper [Abstract No. 82 (1906)] as to the rayed appearance of stars. E. H. B.

901. *Rosenhain Metallurgical Microscope.* (Engineer, 101. p. 304, March 23, 1906.)—Illustrated. Made by Beck and Co. [Wrongly spelt as Rosenheim.]

902. *Conical Refraction.* **W. Voigt.** (Ann. d. Physik, 19. 1. pp. 14-21, Jan. 18, 1906.)—A treatment of conical refraction on the electromagnetic theory of light in which the special cases of plane-polarised, circularly-polarised, and elliptically-polarised incident light are discussed. [See also Abstract No. 313 (1906).] **E. H. B.**

903. *Recent Progress in Magneto-optics.* **P. Zeeman.** (Engineering, 81. pp. 455-456, April 6, 1906. Paper read at the Royal Institution, March 30, 1906.)—An account of the subject from its beginnings with Faraday in 1845. It deals with the electron theory, separation of spectrum lines, rotation of the plane of polarisation in vapours for rays propagated along the magnetic lines, double-refraction at the sides of the D-lines when light traverses sodium vapour at right angles to the field, and the detection of series in the apparently irregular grouping of spectrum lines.

G. E. A.

904. *Fluorescence produced by Secondary Radiation.* **K. Siegl.** (Phys. Zeitschr. 7. pp. 106-107, Feb. 15, 1906.)—The secondary radiation given out by various substances when placed in the path of the rays from radium was investigated by means of the fluorescence excited by that radiation on a screen of barium platino-cyanide. The secondary radiation was observed to increase with the atomic weight.

J. J. S.

905. *Radio-active Substance from the Transvaal.* **R. L. Cousins.** (Chem. News, 92. pp. 203-206, Nov. 3, and pp. 215-219, Nov. 10, 1905. Paper read before the British Assoc., S. Africa Meeting, 1905.)—An alluvial deposit arising from the overflow of a volcanic vent was found to exhibit radio-activity, this being greater in a closed than in an open vessel. From chemical examination of the material it is concluded that the radio-activity is due to radium derived from titanium. **T. H. P.**

906. *Properties of α -Rays.* **H. Becquerel.** (Comptes Rendus, 142. pp. 365-371, Feb. 12, 1906. Phys. Zeitschr. 7. pp. 177-180, March 15, 1906.)—The author has previously doubted the correctness of Rutherford's view that the α -rays from radium are non-homogeneous, and that their velocity is altered by passing through layers of Al-foil [see Abstracts Nos. 2062 (1905) and 303 (1906)]. He has now repeated his experiments, and concludes that Rutherford is in the right. **R. S. W.**

907. *Radio-activity of Drinking-water Sources.* **F. Dienert and E. Bouquet.** (Comptes Rendus, 142. pp. 449-450, Feb. 19, and pp. 883-885, April 9, 1906.)—The authors have tested several of the Avre sources of the Paris water supply, to obtain an explanation of the absence of the *bacillus coli communis* in several of the waters emerging from some but slightly filtering soils. Engler and Sieveking's method was employed [see Abstract No. 2188 (1905)]. The waters are all feebly radio-active, the most strongly active water being that which is quite free from the bacillus. The radio-activity of the air due to the escaping emanation is also given. **L. H. W.**

908. *Radio-activity of the Springs of Fiuggi, near Anticoli.* **R. Nasini and M. G. Levi.** (Accad. Lincei, Atti, 15. pp. 307-308, March 18, 1906.)—Examined by means of a field electroscope, these waters are found to possess very high radio-activity. The results are to be given later. **S. G. S.**

909. *Action of Radium Emanation on Chronogenic Bacteria.* **C. Bouchard and Balthazard.** (Comptes Rendus, 142. pp. 819-823, April 2, 1906.)

HEAT.

910. *Apparatus for the Determination of the Mechanical Equivalent of Heat.*

H. Rubens. (Deutsch. Phys. Gesell., Verh. 8. 5. pp. 77-86, March 15, 1906. Phys. Zeitschr. 7, pp. 272-276, April 15, 1906.)—A brass tube, 60 cm. long and 4½ cm. in diam., closed at the ends by insulating caps through which project inwards the bulbs of two thermometers, is firmly fixed coaxially within a slightly larger, highly polished, and nickel-plated brass cylinder with closed ends, which can be turned in a vertical plane about a horizontal axis through its middle point. The inner tube contains a cylindrical mass of lead, weighing over 4 kg., of but slightly less diam., and of nearly half its volume, the remainder of the tube being filled with machine oil. Observation windows are provided so that the behaviour of the lead weight can be noted. The tube is quickly turned from one vertical position to another, halt is made for the short period needed for the weight to fall to the bottom of the tube, and the procedure is repeated, the rate of about 10 turns a minute being possible. With this instrument the author has found $J = 424.8$ as a mean of 10 observations with an average variation of 1 per cent. from the mean. The possible errors attending the use of this apparatus are discussed. R. E. B.

911. *Melting-points of Platinum and Palladium.* **W. Nernst and H. v.**

Wartenberg. (Deutsch. Phys. Gesell., Verh. 8. 4. pp. 48-58, Feb. 28, 1906. From the Inst. f. phys. Chemie an der Univ., Berlin.)—Describes a determination of the melting-points of these metals by means of an electrically-heated iridium furnace and the Wanner pyrometer. The pyrometer was calibrated by observations on the known melting-point of pure gold, the scale of the instrument itself being calibrated by means of rotating sectors. The use of the iridium furnace was found to lead to contamination of the platinum with iridium and consequent rise of the melting-point. The authors overcame this difficulty by enclosing the platinum wire in a tube of zirconia, and by check experiments made with a furnace made of an alloy of Pt with only 80 per cent. Ir; they consider that errors from this cause have been entirely eliminated. Their conclusions are summarised as follows: When carefully used, the Wanner pyrometer yields surprisingly accurate results, but for such work the current passed through the small incandescent lamp should be measured with an ammeter. Although calibration with the amylnacetate lamp is sufficient for many purposes, for the most accurate work calibration at the melting-point of gold is preferable, and should be carried out immediately before and after the actual measurements in hand. The optical system of the instrument must be tested for each instrument; the theoretical formula, I proportional to $\tan^2 \alpha$, is only approximately correct, and an empirical correction must be found in each case. The use of rotating sectors has been found satisfactory for this purpose and also for the calibration of smoked glasses. On the assumption that the constant of Wien-Planck's law is 14,600, and taking the melting-point of gold at $1,064^\circ \text{C}$., the melting-point of platinum is found at $1,744^\circ \text{C}$. and that of palladium at $1,541^\circ \text{C}$. W. Ros.

912. *Determination of High Temperatures by means of Chemical Equilibrium.*

H. v. Wartenberg. (Deutsch. Phys. Gesell., Verh. 8. 6. pp. 97-108,

March 30, 1906. From the Inst. f. phys. Chemie d. Univ., Berlin.)—The relation between degree of dissociation of water and temperature is investigated up to temperature $2,800^{\circ}$. At moderate temperatures the percentage of undissociated hydrogen is determined by absorbing the hydrogen after the water has passed through a hot tube, but at high temperatures the partial pressure of the hydrogen is determined by having an iridium wall to the vessel containing the water, which wall allows the hydrogen to pass freely through it. This obviates the difficulty caused by the recombination of the oxygen and hydrogen which occurs in the former experiment when the gases reach the cooler parts of the tube. The temperature is determined by means of a Wanner pyrometer in conjunction with a thermo-couple. The relation between temperature and degree of association is then discussed, and an expression connecting the two is obtained by use of the two heat laws. The remainder of the paper is a comparison of the theoretical with the experimental results. S. G. S.

913. Calorimetry of Volatile Liquids. W. Rosenhain. (Soc. Chem. Ind., Journ. 25, pp. 239–240; Discussion, pp. 240–241, March 31, 1906. Paper read before the Birmingham Section, Feb. 15, 1906.)—For the combustion of liquid fuels in oxygen it has been customary to use a porous material such as asbestos, kaolin, &c., to absorb the liquid. This is open to objection owing to the fact that a certain amount of the liquid usually remains unburnt in the porous material. The author has therefore introduced the use of porous pellets of cellulose of known calorific value, which will absorb about half their weight of liquid. In the case of volatile liquids, such as petrol or ether, it is now proposed to wrap the pellets in tin-foil (or, better, Al-foil) to prevent evaporation; after the first 5 min. even ether was then found to lose only about 1 per cent. in 5 min. The tin-foil readily burns away in the oxygen, and its small calorific value is easily allowed for. T. M. L.

914. Vapour Pressure in Equilibrium with Substances holding varying amounts of Moisture. Part I., F. T. Trouton. Part II., F. T. Trouton and Miss B. Pool. (Roy. Soc., Proc. Ser. A. 77, pp. 292–314, March 29, 1906.)—It is found, both experimentally and theoretically, that the mass of moisture held by a substance like flannel is a function of the hygrometric state of the surrounding air, whatever the temperature. Hence *isoneres*, or lines on a p - t diagram connecting the states of a substance holding constant masses of moisture, coincide with isohygrometric lines, or lines on which the pressure is always a constant fraction of the saturation-pressure. It is further experimentally found that if m is the ratio of the moisture absorbed when the pressure is p to that absorbed with the saturation-pressure P and $r \equiv p/P$ is the hygrometric state, then $(1 - m)/(1 - r)$ is a function of the temperature. These laws are also found to hold when the absorbing substance is a liquid like H_2SO_4 , which itself has practically no vapour pressure. Above the critical temperature there are no isohygrometrics, but *isoneres* still exist, and it is suggested that along them the pressure varies as the absolute temperature. It is then easy to see that a mass of gas which would require an enormous pressure to cause it to condense on a given surface at high temperatures, can be held by the same surface at low temperatures at an exceedingly low pressure. The action of charcoal on air, on which Dewar's method of obtaining high vacua rests, is thus explained, and the general attractive action of a solid on a gas is discussed, as is also the drying of surfaces by reduction of pressure, a method of determining the form of Laplace's molecular attrac-

tion function being then deduced. Lastly, the action of hair-hygrometers is explained by supposing the length of the hair to depend on the actual wetness only, independently of the temperature, and thus on the hygrometric state only. Part II. contains a record of very careful and exact determinations of three isotherms between 20° and 95° C., which are found to agree very approximately with the isohygrometrics corresponding to $r=0.89, 0.54, 0.205$ respectively. R. E. B.

915. *Inversion-points, or Fluids passing through a Porous Plug.* A. W. Porter. (Phil. Mag. 11. pp. 554-568, April, 1906.)—For an infinitesimal difference of pressure at the ends of the plug the inversion-points, with respect to the cooling effect on expansion, are given by $\partial v/\partial T = v/T$ or, in terms of reduced volumes and temperatures, by $\partial \beta/\partial \gamma = \beta/\gamma$. With van der Waals' reduced characteristic this condition becomes $\gamma = \frac{2}{3}(3-1/\beta)^2$, which gives for the corresponding reduced pressure $a = 9(2\beta - 1)/\beta^3$ [and thus—

$$\gamma = (45 - a)/12 \pm \sqrt{(9 - a)}],$$

showing that for all pressures less than 9 times the critical pressure there are two inversion-points, but none for pressures above. Similarly with Dieterici's characteristic $p(v-b) = RT \exp(-a/RTv)$ in its reduced form the condition gives $a = (8-\gamma) \exp(2.5-4/\gamma)$, discussion of which shows that for all pressures below $4e^{1.6} \approx 17.98$ times the critical pressure there are two inversion-points, but none for higher pressures. In both cases the volume corresponding to the inversion-point at the maximum pressure is equal to the critical volume [and the author further concluded, but wrongly, that the two inversion-volumes for a given pressure are proportional to the corresponding inversion-temperatures]. It thus appears that the inversion-temperature is probably a function of the pressure, and that for the same pressure two inversion-points may in general exist, but that different characteristics, while all fair approximations to the behaviour of a real gas, indicate very different values for these inversion-temperatures, so that the experimental determination of the latter may be a very valuable and sensitive means of discriminating between the relative validity of different characteristics. In this connection a discussion of Olszewski's determination of the inversion-point for hydrogen—in this case, however, with large fall of pressure—seems to indicate that in the region involved van der Waals' equation is more valid than either of those proposed by Dieterici. With Rose-Innes' characteristic for isopentane consideration shows that the trend of the inversion-point curve for large volumes on a vT -diagram [and also that on a pT -diagram for volumes greater than about 1.5 times the critical volume] is of opposite sign to that for the other characteristics. Is it possible, therefore, that the rigorously valid characteristic for an actual gas has its inversion-point curve parallel to the pressure axis, so that there is but a single inversion-point? A modification of Rose-Innes' equation is determined, which has this property and corresponds well with observed values. R. E. B.

916. *Extension of pV^k Expansion Law.* R. H. Smith. (Eng. Rev. 14. pp. 241-245 and p. 271, April, 1906.)—A method is here suggested of determining the constants P, V, K, i of that curve of form $(p+P)(v+V)^i = K$ which nearly represents a given expansion curve. If W_{12} is the area between the ordinates of two points on the curve, the curve and the v -axis, then $(i-1)W_{12} = p_1v_1 - p_2v_2 + (p_1-p_2)V - (v_2-v_1)Pi$. Thus we have to choose

four suitable points on the curve and measure the corresponding areas by a planimeter, with the special advantage that the shape of the actual curve between the chosen points is thus taken into account. R. E. B.

917. *Characteristic Equations in their Relation to Thermodynamics.* A. Byk. (Ann. d. Physik, 19. 3. pp. 441-486, March 2, 1906.)—The necessity of the existence of a relation of the form $p=f(v,T)$ is investigated from consideration of the two laws of thermodynamics and of certain radiation operations that occur in a vacuum. Temperature being defined electromagnetically, the determinateness of the temperature of a homogeneous body on its mass, volume, and energy is first shown, a cyclical process being described which leads to a contradiction of the second law if the temperature can vary while the mass, volume, and energy remain constant; it is further similarly shown that the pressure is determined by the mass, volume, and energy; consequently elimination of the energy gives the pressure in terms of the temperature and specific volume. It is then shown that for chemical compounds the characteristic is of the form $F(p, T, M_1/V, M_2/V, \dots) = 0$, or $v = \chi(p, T, M_1/M_n, M_2/M_n, \dots)$, as given by Nernst and Planck. R. E. B.

918. *Gaseous-liquid State.* Part II., A. Schükarew. Part III., A. Schükarew and M. Tschuprowa. (Zeitschr. Phys. Chem. 55. pp. 99-112, and 125-127, March 20, 1906.)—In order to extend his former work to other liquids [see Abstract No. 770 (1905)], the author has devised a method of directly determining the heat of condensation of superheated vapours at ordinary pressure which, in spite of the large corrections for radiation and conduction, amounting to 10 or 15 per cent., seems to give exact results. Vapour from the boiling liquid passes through four bulbs, one vertically above another, filled with metal filings and immersed in a liquid of high boiling-point which is electrically heated, the containing vessel standing immediately over the cooler of the calorimeter. By this apparatus the heats of condensation of ethyl ether, isoamyl, and isopentane were determined under about 74 cm. pressure at about 101°, 203°, 806° C., and their intrinsic energy was investigated as formerly, the conclusions drawn being exactly the same as those given before. In the last part of the research mixtures were investigated, and it was found that the intrinsic energy of a mixture of two concentrated vapours is not equal to the sum of the intrinsic energies of the two components when each occupies the same volume as the mixture, but that it is approximately so equal if the volume of the mixture is equal to the sum of the volumes of the components. R. E. B.

REFERENCES.

919. *A Gas Calorimeter.* C. V. Boys. (Roy. Soc., Proc. Ser. A. 77. pp. 122-130, Feb. 8, 1906.)—The author, after referring to the defects of the Hartley and Junker gas calorimeters, describes one that has been specially designed for convenient and accurate work in connection with the change in the law respecting the testing of London gas. The new calorimeter can be taken entirely to pieces in a few minutes, and the surfaces exposed to acid vapours washed in dilute alkaline solutions. A description of the apparatus follows. A diagram shows the results that may be attained with this instrument. J. B. C. K.

920. *Heat of Vaporisation of Liquid Oxygen and Nitrogen.* H. Ait. (K. Bayer. Akad. Wiss. Abh. II Kl. 22. Part 3. Ann. d. Physik, 19. 4. pp. 739-782, March 27, 1906.)—A fuller account of the work already dealt with in Abstract No. 1437 (1905).

SOUND.

921. New Resonator. A. Fiorentino. (N. Cimento, 10. pp. 254-257, Oct., 1905.)—A number of very fine glass rods, or threads, are fixed at one end to a stout glass rod and stand out at right angles to the latter, one end of which rests against a rubber diaphragm stretched across the end of a tube 4 cm. in diam. The threads have different lengths, and each one is set in violent transverse vibration when the diaphragm vibrates in the proper period of the thread. The threads, when once tuned to certain periods, constitute very delicate resonators, and by means of optical projection the presence of overtones in a string, pipe, or the voice may be made evident to an audience. S. G. S.

922. Telephone Diaphragms. M. Wien. (Ann. d. Physik, 18. 5. pp. 1049-1058, Dec. 28, 1905. Phys. Inst. d. techn. Hochschule, Dantzig, Nov. 22, 1905.) Wiersch has recently shown that if diaphragms of very high natural frequency be taken, speech is rendered more clear [see Abstract No. 2282 (1905)]. The author investigates the action of some small diaphragms whose natural frequency is very high, 12,000 to 20,000. He finds the telephone sounds are very clear, but faint sounds are lost. The intensity is the same for all tones of the same magnitude, and varies as the square of the amplitude. The intensity depends on n , the frequency of the impressed vibration, and p , the lowest natural frequency of the diaphragm, and varies as $1/(n^2 - p^2)^2$. Hence for diaphragms of high frequency n may be ignored, and the intensity varies as $1/p^4$, a small quantity when p is great. The author considers that any research on speech which confines itself to the measurement of the amplitude of the tones, as found by harmonic analysis, is incomplete. P. E. S.

923. Generation of Tone in Organ-pipes. R. Wachsmuth and A. Kreis. (Deutsch. Phys. Gesell., Verh. 8. 5. pp. 60-76, March 15, 1906.)—There are two ways in which one can force a resonator to continue sounding. First, a tuning-fork may be sounded near the mouth of the resonator, and if the fork is in tune with it a strong response is elicited. Second, the resonator may be blown. The question arises as to how the tone is elicited by the blowing. V. Hensen takes the view that an air-current draws the surrounding still air into its motion. So that, in his view, secondary currents at right angles to the main one occur on each side of it. Following up this idea, a theory of the action of blowing an organ-pipe was put forward [see Abstract No. 1444 (1905)]. The present authors take another view, more nearly agreeing with the excitation of a resonator by a tuning-fork. It is well known that an air-blast directed against an edge generates a tone, here called a "cutting tone" (Schneiderton). Further, the frequency of this tone depends on the strength of the air-current producing it, and rises with increasing velocity of this air-blast. Thus the air-current striking the edge of the organ-pipe's mouth is likened to a reed whose pitch rises as the air-pressure is increased. Whenever the air-blast and direction of the current are so adjusted that the pitch of this aerial reed agrees with one of the tones proper to the pipe, or other resonator, that tone is elicited. After experiments to test this hypothesis, the authors' chief conclusions are as follows: The generation of tones in flue or flute-pipes and all of similar construction may be fully explained by the theory of "cutting" tones. The other motions of the air present in the pipe have only a secondary significance. [See also Abstract No. 2647 (1904).] E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

924. *Electric Resistance to the Motion of a Charged Conducting Sphere.* G. W. Walker. (Roy. Soc., Proc. Ser. A. 77. pp. 260-273, March 29, 1906.)

—This is an application of the method employed by Love in investigating the mode of decay of vibratory motion to the motion of an electrified spherical conductor in free space or in a field of force. Love has shown that there is no resultant mechanical force on the sphere if the electricity upon it is initially distributed with a surface-density proportional to the first zonal harmonic, P_1 ; if, however, the sphere has a resultant charge equivalent to the superposition of a uniform surface-density upon that proportional to P_1 , the author finds that there is a resultant mechanical force on the sphere in the direction of the axis of the harmonic P_1 . The consequent motion is discussed, but the results are too intricate for abstract; the necessity, however, is emphasised of considering the equations for the sphere and the medium side by side; for even when it is possible to get a differential equation for the displacement of the sphere, it appears that we cannot determine the constants of integration without a knowledge of the state of the medium. R. E. B.

925. *Spherical Radiation in a Biaxial Crystal.* H. B. A. Bockwinkel. (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 636-651, Feb. 7, 1906. Proc. 8. pp. 728-742, March 22, 1906.)—In the electromagnetic theory of light it is of interest to determine the electromagnetic field in a crystal due to an action taking place in a certain centre O. In order to fix the ideas, suppose that in an element of space r at the point O there are certain periodic e.m.f.'s. There will then be a radiation of energy from O in every direction, the amount of which will depend on this direction with respect to that of the e.m.f. and to those of the axes of electric symmetry. The object of the present paper is to investigate this dependence for points at a great distance from O. The paper is highly analytical, and obtains expressions for the electric force, energy, and activity in any cone of rays whose vertex is at O. E. H. B.

926. *Electrification of Crystals by Deformations.* P. P. Koch. (Ann. d. Physik, 19. 3. pp. 567-586, March 2, 1906. Phys. Inst. d. Univ., München.)—This paper deals with a number of observations on the generation of electricity in quartz and tourmaline by homogeneous and heterogeneous deformations. The work concludes with a quantitative determination for tourmaline, showing that an increase of pressure of 1 kg. per sq. cm. gave a charge of 0.0186 electrostatic unit to a piece of crystal of 0.287 c.cm., whence the electric moment per unit of volume for a change of pressure of 1 dyne per sq. cm. is 8×10^{-6} c.g.s. unit. The piezoelectric modulus of green Brazilian tourmaline, found by Rieche and Voigt, yields, on the theory of Voigt, a constant for the hydrostatic pressure, here directly determined, of the value 7.8×10^{-6} , the two being in good agreement. E. H. B.

DISCHARGE AND OSCILLATIONS.

927. *Velocity of Ions produced by a Flame.* G. Gianfranceschi. (Accad. Lincei, Mem. 5, pp. 594-619, 1905.)—The author describes a modification of J. J. Thomson's method for measuring the velocity of ions produced by a flame. Results obtained by the new method show that the variation of the potential in the region between a flame and two plates parallel with it is sensibly the same for the positive as for the negative flame. The curves representing this variation exhibit, however, appreciable differences according as the p.d. between the plates is high or low. The curve has a true maximum corresponding with the top of the flame. The force is zero in the flame, but outside of the latter rapidly increases to a value which is maintained nearly up to the plate, where rapid increase again occurs. Just outside of the flame, the electrical density produced by the ions of either sign reaches a maximum, afterwards falling to a minimum, which is maintained constant over a certain space; near the plate, it increases. The space over which the density remains constant is the smaller the larger the p.d. between the plates. The formulæ given by J. J. Thomson and by Child do not accurately express the velocity of the ions. The results obtained are better in accordance with the expression $k = 4\pi i / (X \cdot dX/dx)$, where i represents the current and X the electric force, and x is the direction given by the common normal to the two plates. All the elements in this formula are measured at one and the same point, so that the velocity obtained is the true specific velocity of the ions at that point and not merely the mean value over a certain space. The specific velocity of the ions depends on (1) the intensity of the flame; (2) the difference of potential between the plates, and (3) the distance from the flame. The numbers obtained agree very well with those given by Mache [Abstract No. 8274 (1904)], but differ from those of Child [Abstract No. 847 (1901)] and of McClelland [Abstract No. 100 (1899)]. The value arrived at for k_+/k_- is in complete accord with that given by Mache and is very near to that obtained by Zeleny [Abstract No. 251 (1899)].

928. *Electrical Conductivity of Flames containing Salt Vapours for rapidly alternating Currents.* H. A. Wilson and E. Gold. (Phil. Mag. 11, pp. 484-505, April, 1906. Communicated by the Physical Society.)—A Wheatstone bridge is formed by means of four capacities, one of which is in the flame. An alternating current from a Tesla coil is sent through this bridge, and the variation in the capacity placed in the vapour is found by adjusting one of the other condensers. The indicating instrument is an electrolytic detector. The salts are sprayed into the flame in the usual way, and their relative conductivities are obtained from the increase in the apparent capacity of the flame condenser. It is found that the vapours of the alkalis behave like a dielectric of high specific inductive capacity; the conductivity of different vapours varies as the square root of that for steady currents. The apparent capacity is nearly independent of the frequency and of the distance between the electrodes.

929. *Recombination of Ions.* W. H. Bragg and R. D. Kleeman. (Phil. Mag. 11, pp. 466-484, April, 1906. From Roy. Soc. of S. Australia, Trans. Vol. 29, 1905.)—The relations between current and field in an ionised gas have been studied by many workers, and the agreement between experiment and theory is partly, but not completely, satisfactory. If n and p be the number of negative and positive ions per c.cm. and η represents the

number of recombinations per unit time, according to the usual theory. The authors point out that a newly-released electron may be in a position specially favourable for recombining with its original atom; for the field they exert on each other at the distance of the mean free path is 900 volts per cm., which is large compared with that usually used to remove the ions from the gas. The number of ions failing to reach the electrodes on this account, which is here called initial to distinguish it from general recombination, will be proportional to those formed per sec., will be independent of the shape of the vessel, and will be the more noticeable the smaller the general recombination is. The last condition is fulfilled by making n^2 small, n being the number of either sort of ion in each c.cm. Retschinsky has previously attributed some discrepancies to absorption of the ions by the electrodes. The theory also explains the fact that it is more difficult to get complete saturation for a dense gas. In this case, on account of the larger number of atoms in the molecule, the latter may have lost several electrons and so a stronger field will exist; in addition the free path is less. Previous work has inclined the authors to the view that the α -particles from radium perform the same number of acts of ionisation in every gas. They now conclude that the total number of ions set free is independent of the pressure, but is different for different gases, e.g., is greater in ethyl chloride than in air.

R. S. W.

930. *Most probable Value of the Ratio ϵ/μ_0 for an Electron in Kathode Rays.* C. E. Guye. (Comptes Rendus, 142. pp. 833-836, April 2, 1906.)—In the two equations $\frac{1}{2}\mu'v^2 = U_e$, $\rho = v\mu_2/H_e$, it is usually assumed that μ' and μ_2 are equal, so that $\epsilon/\mu = 2U/H^2\rho^2$. This equality, however, is exact only if the velocity v is sufficiently small, so that in general we have $\epsilon/\mu_2 = (\mu_2/\mu') 2U/H^2\rho^2$, and Simon's experiments give $\mu_2/\mu' = 0.9928$ on the average. This reduces Simon's results to $\epsilon/\mu_2 = 1.852 \times 10^7$ and $\epsilon/\mu_0 = 1.878 \times 10^7$ as the most probable values, the latter referring to infinitely slow velocity; and these numbers correspond more closely than when uncorrected with Kaufmann's estimates for the electrons from radium.

R. E. B.

931. *Conditions for Sparking at Break of an Inductive Circuit.* J. C. Hubbard. (Phys. Rev. 22. pp. 129-158, March, 1906.)—The author has investigated the relation between the velocity of break of the circuit, the steady current, the capacity and the inductance of the circuit, when the conditions are such as to just prevent a spark being formed at breaking, this being the condition for the production of maximum e.m.f. in a secondary, to which the above circuit is the primary. It is first shown that the velocity of break just necessary to prevent a spark is to a first order of approximation proportional to the natural frequency of oscillation of the circuit and to the excess of maximum potential over the minimum spark-potential. The circuit is broken by means of A. G. Webster's drop chronograph [see Abstract No. 88 (1899)], the ends of the circuit at a known short interval later being connected to the terminals of a quadrant electrometer. The resulting p.d. is constant for given current, capacity, and inductance, when no spark occurs, but as soon as a spark is produced the readings become erratic. The potential gradients necessary to produce the spark as calculated from these observations are much higher than those found by Earhart, for static p.d.'s [see Abstract No. 514 (1901)], and the author considers that this is due to the "lag" effect in the spark, owing to the fact that time is required to produce the ionisation necessary to enable the air in the gap to become conducting. The experi-

mental results are summarised as follows: The necessary velocity of break is (1) a linear function of the initial current, and (2) for given current increases in value in a manner consistent with the equation when the capacity is diminished; and (3) diminishes according to equation as the inductance is diminished.

932. *Positive Column in Vacuum Discharges.* P. Villard. (Comptes Rendus, 142. pp. 706-709, March 19, 1906.)—The positive light-column is best studied at a pressure at which it is far removed from the walls of the tube, say, 1 to 5 cm. of mercury. The magnetic deviation of the positive column is essentially different from that of the cathode rays. Where the magnetic field is a maximum, the deviation is zero. The positive column behaves in fact like a flexible and extensible string repelled by the walls and pulled towards the electromagnet by a pulley. Where the displacement is greatest the direction of the column is parallel to its original direction. The positive column behaves like a current filament, instead of a bundle of projected particles. It bends so as to increase the magnetic field, and when the latter is increased independently the diam. of the spiral described by the positive column increases. The author inclines to the belief that the particles constituting the positive column are stationary, or move but slowly. The column loses its positive charge as it advances towards the kathode, but every portion of it is attracted by a negative charge. When passing over the opening of a side tube, it bends towards it, under pressure from the opposite wall.

933. *Study of the Intermittent Discharge.* G. Millochau. (Comptes Rendus, 142. pp. 781-783, March 26, 1906.)—A system of electrodes called a capillary exploder consists of two wires each enveloped in a glass tube which ends in a very fine capillary. The wires are placed opposite to each other in the shape of a V inverted. The two wires being connected to the poles of an induction coil and a regular spark obtained between the ends, the spark takes a particular form for a given diam. of the capillary, neighbouring metallic masses become the seat of inductive effects and sparks may be drawn from them. On examination of the spark with the photographing apparatus of Janssen it proves to be intermittent, being broken up into groups with an intermittence of about $4/10,000$ ths of a second. In four groups recorded on one proof, the first two contained six and the last two consisted of three sparks.

934. *Variation of Temperature in the Stratified Discharge.* H. Geiger. (Deutsch. Phys. Gesell., Verh. 8. 6. pp. 116-118, March 30, 1906.)—The apparatus is designed for lecture demonstration rather than for quantitative measurement. The kathode is a thin sheet of platinum covered with a layer of calcium oxide and heated by an auxiliary current as used by A. Wehnelt [see Abstract No. 2672 (1904)]; the anode is a fixed Al ring, and as temperature measurer one junction of a fine wire thermo-couple (Pt—Pt-Rh) is used, which can be moved along the tube. The currents employed vary from 0.09 to 0.40 amp., and it is found that the difference between the temperature of the glow and the intervening dark spaces varies irregularly but is of the order of 25° to 50° . As the current increases the temperature rises, but not so rapidly as the current increases. Experiments of a more exact character are to be given later.

935. Energy, Duration, Damping, and Resistance of Condenser Sparks. A. Heydweiller. (Ann. d. Physik, 19. 4. pp. 649-691, March 27, 1906. Phys. Inst. d. Univ., Münster, Jan., 1906.)—An elaborate paper, mostly mathematical, whose chief results may be summarised as follows: (1) The agreement found by J. Koch for small spark-gaps for spark discharges and glow discharges is confirmed for gaps up to 6 mm., and may be covered by the known differential equations of G. Kirchhoff and Kelvin for sparkless condenser discharges if extended by additional terms for the spark-gaps. (2) Under certain special cases which render some small quantities negligible, this generalised differential equation may be integrated and two spark constants determined from experiments. (3) Observations furnish spark constants in fair agreement with those for glow discharges. (4) From the spark constants and the known discharge-potential all the other quantities sought may be obtained. E. H. B.

936. Resonators in Radiation Field. E. Aschkinass. (Ann. d. Physik, 19. 4. pp. 841-852, March 27, 1906. Phys. Inst. d. techn. Hochschule, Charlottenburg, Jan., 1906.)—A commentary on the recent work of M. Paetzold on this subject [see Abstract No. 570 (1906)]. It is particularly pointed out that as regards the so-called multiple resonance the two views which were once thought opposed may be reconciled. For on the view of Sarasin and de la Rive the oscillator gave out radiations forming a spectrum. Whereas, as shown by Bjerknes, the oscillator gave out a damped simple harmonic motion, the so-called multiple resonance following from the strongly-marked damping of the radiation from the oscillator and the very slight damping of the resonator itself. The two views are harmonised by the proof by A. Garbasso that a strongly-damped vibration may always be expressed by a Fourier integral, i.e., by the superposition of an infinite series of undamped vibrations of different periods [see Abstract No. 1925 (1901)]. E. H. B.

937. Damping of a Condenser Circuit. T. Noda, with an addition by P. Drude. (Ann. d. Physik, 19. 4. pp. 715-738, March 27, 1906.)—The damping factor of a condenser circuit may be reduced by adding another condenser circuit as closely as possible to the spark-gap. Two vibrations are produced, one of them having a constant period somewhat longer than the primary vibration, while the period of the other is a function of the ratio between the periods of the two circuits. These two vibrations the author designates by I. and II. For equal capacities the damping of vibration I. is always smaller than that of vibration II. By adding a capacity about 50 times as large as that in the primary circuit, the damping of vibration I. may be reduced to 0.047, and the damping of vibration II. to 0.023, if the ratio of periods is properly chosen and if the secondary circuit contains the same capacity as the primary. The curve of resonance is then very decided. P. Drude corroborates the reduction of damping by the addition of a condenser circuit, but he failed to discover the vibration II., which he attributes to possible overtones. E. E. F.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

938. Present State of the Accumulator Industry. Jumau. (Soc. Franç. Phys., Bull. 2. pp. 181-227, 1905. Abstracts in Rev. Électrique, 3. pp. 806-808, May 30, 1905. Centralblatt Accumulatoren, 7. pp. 95-108,

April 20, 1906.)—This lengthy paper forms a complete treatise dealing with modern experimental results and theoretical views concerning the properties and behaviour of the lead accumulator, later chapters being taken up with a consideration of accumulators of metals other than lead. Numerous curves are given. The author calls attention to the dependence of the capacity of a lead cell upon the molecular state of the active material, which relation, he states, does not appear to have been referred to previously. The effect is most marked in the case of the negative, two exactly similar negatives, made under the same conditions, and consequently having the same apparent density, showing quite different capacities according to the conditions under which reduction was carried out. This is due to the variable size of the crystals of spongy lead. In the reduction of a chloride negative with zinc, the crystals obtained will be larger, for the same concentration of the electrolyte, the more feeble the reduction; and the capacity afterwards shown by the plate will be smaller the more feeble the intensity of the reduction.

L. H. W.

939. *Electrical Conductivity of Metallic Oxides.* F. Horton. (Phil. Mag. 11. pp. 505-531, April, 1906.)—The resistance of various solid metallic oxides is measured, by a bridge method, at various temperatures. The emission of corpuscles from hot bodies has been shown by various physicists to agree

with the formula $n = Ae^{\frac{b}{\theta}}$, where n is the number of corpuscles, θ the absolute temperature, and A and b are constants. The conductivity is found to obey a similar formula. Some of the substances, e.g., CuO, show no electrolysis, others show traces. The increase of conductivity with temperature is much more rapid than in any known case of electrolytic conductivity. As the oxides remain solid throughout, this increase can scarcely be due to an alteration in the mobility of the ions; it must therefore be ascribed to an increase in their number—a supposition which is not compatible with the idea that the conductivity is electrolytic. The author concludes, in opposition to Nernst, that the conductivity is due in great measure to the movement of negatively-charged corpuscles, as in metals.

R. S. W.

940. *Thermo-electric Heterogeneity in Certain Alloys, especially German Silver.* E. H. Hall, L. L. Campbell, and S. B. Serviss. (Amer. Acad., Proc. 41. No. 25. pp. 543-574, March, 1906. Contribution from the Jefferson Physical Laboratory, Harvard University.)—Describes accurate calibrations and tests of thermo-couples of copper-German silver, copper-manganin, and copper-constantan over the range from 100° to 218° C. (boiling-point of naphthalin). When attempting to measure the difference of temperature between two regions which were approximately at 140° and 180° respectively, discrepancies were observed on reversing the hot and cold junctions, and since the wires had been carefully guarded against strain, local peculiarities were looked for in the wires. As regards the effects of strain, couples were tested made of straight unstrained wire and a portion of the same wire wound spirally upon a core 1 cm. diam. and also couples made of unstrained wire and the same wire which had been stretched 10 per cent.; in the first case the mean e.m.f. was found to be about 0.07 per cent., and in the latter 0.6 per cent. of that of a German silver-copper couple under the same temperature conditions. The application of the sharp edge of a piece of ice to a straight piece of German-silver wire exposed to the air of the room, this application being many cm. distant from either end of the wire, developed

a perceptible e.m.f. which frequently changed its sign as the point of contact was moved 1 cm. at a time along the wire. Annealing was found to change the local distribution of this heterogeneity and to increase its range: stretching annealed wire to a permanent extension of 10 per cent. made very little difference in this respect, but re-annealing the stretched wire again changed the distribution and increased the range of the peculiarities. In wire so treated, contact at one point with an edge of ice developed an e.m.f. about 0.2 per cent. of that produced by applying ice to a copper-German silver junction. These tests show that there may be in straight, recently-annealed German silver wire local differences of thermo-electric quality which may cause serious error if the couple be used to measure small differences between two high temperatures, the intermediate part of the couple being exposed to air at the temperature of the room; to avoid these errors the temperature interval of the junctions should be reversed whenever practicable. By keeping the intermediate parts of the German-silver wires near the temperature of the cooler junctions, the discrepancies in the calibration tests on reversing with a temperature-interval of 40 were reduced from an average of about 8 per cent. to an average of about 0.8 per cent. If $2,100 \times 10^{-8}$ volt be taken as the "thermo-electric height" and 4.8×10^{-8} as the rate of increase per 1° rise of temperature, values from 0 to 218 will be obtained which do not differ by more than 1 per cent. from the most probable value for any point. A piece of manganin wire tested with ice as described above behaved very much as the German silver, but a piece of constantan wire showed much smaller local effects than the German silver—about one-fifth as great—and these were not increased by annealing. With the reservation that their tests were made on only one specimen of constantan and only one kind of German silver, the authors point out that their results indicate that copper-constantan couples are to be preferred to copper-German silver couples for ordinary use. W. Ros.

941. *Adjustment of d'Arsonval Galvanometer for Ballistic Work.* F. Wenner. (Phys. Rev. 22, p. 192, March, 1906. Abstract of paper read before the Amer. Phys. Soc., Dec. 29-30, 1905.)—The suspension constant, strength of magnetic field, resistance of circuit, and moment of inertia of coil, which is stripped of its dampers, are so adjusted that the coil comes to rest in its zero position in least time without oscillation; this time should be about 15 to 20 sec. The galvanometer may then be used on closed or on open circuit, the ballistic constant being e (base of Nap. log.) times as great in the former case as in the latter; and the calibration may be performed with a condenser and standard cell, with a standard solenoid, or calculated from the figure of merit and the period of oscillation on open circuit. S. G. S.

942. *C. Ropiquet's Mercury Turbine Interrupter.* (Archives d'Él. Médicale, 14, pp. 187-195, March 10, 1906.)—The interrupter described can be used direct on any circuit of 100-220 volts without regulating resistance or condenser. The discharge obtained is said to be as intense as with a Wehnelt break, and takes only one-fifth the energy. The turbine itself is an Archimedean screw arrangement which raises the mercury and forces it out of the jets, which latter are on two rotating radial arms. The mercury does not in this apparatus form one electrode, but merely makes connection between the two fixed electrodes. Each jet impinging upon these electrodes is cut in half by a knife-edge of insulating material as it reaches the end of such electrode, the jet being thus simultaneously broken at four places. The

speed of the mercury projected from the jet (17.5 m. per sec.) is adjusted to be twice that due to the rotation. Illustrations are given and the use of the interrupter is explained. L. H. W.

943. Deflection Potentiometers. H. B. Brooks. (Electrical World, 47. pp. 564-565, March 17, 1906. Abstract. Écl. Electr. 47. pp. 238-240, May 12, 1906.)—Describes an instrument in which when a balance is nearly obtained in a potentiometer, something under 1 per cent. of its value is given by the deflection on the galvanometer. This is effected by having a suitable compensating resistance in the galvanometer circuit, which is altered as the potentiometer slider is moved, in such a manner that the deflection on the galvanometer is always proportional to the voltage to which the want of balance is due. The theory of the instrument is worked out and a description of one made at the U.S. Bureau of Standards given. [Details are to be given later in Bureau of Standards, Bull.] E. C. R.

ALTERNATING CURRENTS AND MAGNETISM.

944. The Magnetic Detector. F. Lori. (N. Cimento, 10. pp. 297-309, Nov., 1905. Paper read before the Accademia di Padova, Jan. 14, 1906.)—The author gives a new theoretical treatment of the magnetic detector, intended to supplement the work of Garibaldi, Piola, Ascoli, and Arnò [see Abstracts Nos. 2977 (1904), 1047, and 1048 (1905)]. An iron wire wound with two coils, but movable independently of them, revolves in a plane containing the magnetic lines of force between the poles of an electromagnet. The flux through the iron changes most abruptly at four points near the poles. When the wire revolves these points are shifted in the direction of revolution, owing to hysteresis. The wire is pulled back by magnetic attraction, and work has to be spent to continue its rotation in the same direction. A transient current in the inner coil round the wire will induce another in the outer coil, and these currents will modify the magnetic flux through the iron. The area of the hysteresis cycle is thereby diminished. The wire must be reduced to its original condition by a further rotation, and this is done at the expense of the energy producing the rotation. The rotating apparatus acts as a kind of relay, and the current induced by the incident wave brings this relay into action. E. E. F.

945. Magnetic Behaviour of Iron Powder. W. Trenkle. (Ann. d. Physik, 19. 4. pp. 692-714, March 27, 1906. Extract from Inaug. Dissertation Erlangen, Dec. 16, 1904. Écl. Electr. 47. pp. 139-142, April 28, 1906.)—An account of experiments on the magnetic behaviour of iron powder mixed in various proportions with non-magnetic earths; both the magnetometer and the ballistic methods were used. The chief results are as follows: (1) Under equal magnetising fields the susceptibility of pure iron powder is always greater than that of a mixture of iron powder with a non-magnetic substance. Accordingly the saturation value for pure iron powder is always higher than that of the dilution. (2) The magnetisation of the iron always sinks with the density, and the magnetic saturation value is lower, the lower its density is. (3) The magnetising field needed to give saturation is greater for pure iron powder than for dilutions. E. H. B.

REFERENCES.

946. *Employment of Symbolic Method in the Solution of Equations arising in Electrodynamics.* G. Giorgi. (Atti dell' Assoc. Elett. Ital. 9. pp. 651-699, Dec., 1905.)—The paper is a discussion of the employment of the symbolic method to the solution of various problems. The expression $f(\Delta)V(t)$ is expressed as a Fourier's double integral; Δ is the operator $(\partial/\partial t)$ and $f()$ is an analytical function of constant coefficients, $+V()$ any function whatever of the real variable t . It is shown that Δ may be treated as a numerical quantity. The paper is purely mathematical and is too long to abstract adequately. [See also Abstract No. 1946s (1904).] S. G. S.
947. *Constitution of the Electron.* W. Kaufmann. (Ann. d. Physik, 19. 8. pp. 487-553, March 2, 1906. Ecl. Electr. 47. pp. 86-96, April 21, and pp. 125-139, April 28, 1906.)—A much fuller treatment of a paper already dealt with [Abstract No. 837 (1906)].
948. *Electrostatic Field surrounding two Special Columnar Elements.* P. W. Bridgman. (Amer. Acad., Proc. 41. No. 28. pp. 617-626, March, 1906. Contribution from the Jefferson Phys. Lab., Harvard University.)—Lines of force and potential are drawn for 8 different two-dimensional cases which constitute all possible combinations of two elliptic or hyperbolic elements (so named from the shapes of their equipotential lines) with their centres at unit distance apart and their directions at right angles. The results are obtained by the combination of the simple functions $x = \cosh \phi \cos \psi$, $y = \sinh \phi \sin \psi$. R. E. B.
949. *Equations of Motion and Electromagnetic Energy of Electrons.* E. Kohl. (Ann. d. Physik, 19. 3. pp. 587-612, March 2, 1906.)—A highly analytical paper dealing with the field energy, the electron energy, and the motions of the electrons both of translation and rotation. In the case of certain swarms of electrons, it is shown that they exert no ponderomotive actions on each other or their parts since the expression for their energy is independent of their form. [See Abstracts Nos. 1729 (1904) and 381 (1905).] E. H. B.
950. *Aeolotropic and Isotropic Ellipsoidal Potentials.* R. Hargreaves. (Phil. Mag. 11. pp. 568-586, April, 1906.)—A highly mathematical discussion of potentials of more general types than those considered in a former paper [see Abstract No. 1409 (1905)]. It is too complicated for abstract. R. E. B.
951. *Parallelism of Electric and Magnetic Magnitudes.* J. A. Vollgraff. (Archives Néerlandaises, 11. pp. 169-183, 1906.)—The views of various writers are discussed in relation to theories that have been proposed and observations that have been made, and in the result the author leans to those of Cohn. R. E. B.
952. *Magnetism and Electricity.* Harckman. (Soc. Belge Élect., Bull. 23. pp. 81-86, Feb., 1906.)—A development of de Heen's conception of the atom, so as to explain electrostatic as well as magnetic condition. A. D.
953. *Sparking Potentials.* M. Toepler. (Ann. d. Physik, 19. 1. pp. 191-209, Jan. 18, 1906. Ecl. Electr. 46. pp. 341-344, March 3, 1906.)
954. *Mechanism of the Disruptive Discharge.* P. Langevin. (Soc. Int. Élect., Bull. 6. pp. 69-91, Feb., 1906.)—Contains an exceptionally clear account of Townsend's theory of the origin of the disruptive discharge as caused by ionisation by collision. R. S. W.

955. *Kathode Rays and Aurora Borealis*. **P. Villard**. (Soc. Int. Élect., Bull. 6. pp. 45-67, Feb., 1906.)—An account of magneto-kathode rays. The author also attempts an explanation of the Aurora Borealis from the known effects of a magnet on kathode rays. R. S. W.

956. *Electric Discharge and Spectroscopy*. **J. J. Thomson**. (Engineering, 81. pp. 124-126, Jan. 26, 1906. From Lecture delivered before the Royal Institution, Jan. 19, 1906. Ecl. Électr. 46. pp. 459-462, March 24, 1906.)—Given here under title "Mechanics of Luminosity."

957. *On the Differential Transformer*. **J. Trowbridge**. (Phys. Rev. 20. pp. 65-76, Feb., 1905.)—Referring to Duane and Lory's results with the differential telephone [see Abstract No. 1516 (1904)], the author describes a differential transformer which he prefers to employ. With this transformer he has been able to compare inductances ranging from 7 to 40 millihenries with capacities ranging from 0.05 to 1.0 mfd. to an accuracy of over 1 per cent. with a single observation. L. H. W.

958. *Electric Resistance of Solenoids for High-frequency Currents*. **A. Battelli**. (Accad. Lincei, Atti, 15. pp. 148-160, Feb. 4, 1906.)—Treating the solenoid as generated by a circle whose plane is normal to the direction of the helix and whose centre moves along the helix, the author shows, by employing the equations of electrodynamics, that if the current is everywhere parallel to the generating helix that the distribution of current over the circular section should be independent of the periodicity employed, which result is inconsistent with the known increase of resistance to currents of high periodicity. [See Abstracts Nos. 355 (1904) and 572 (1906).] S. G. S.

959. *Resistance of Emission of an Aerial*. **C. Tissot**. (Comptes Rendus, 142. pp. 703-706, March 19, 1906.)—The "resistance of emission" the author has already defined as that amount of resistance which, assuming no loss of energy by radiation, the aerial should have in order that the damping of the oscillations by the frictional resistance may be equal to that due to radiation only [see Abstract No. 535b (1906)]. He here, from theoretical considerations, derives an expression, involving certain assumptions, which gives for the decrement values of the same order as are obtained experimentally. L. H. W.

960. *Measurement of Small Currents of High Frequency*. **W. Duddell**. (Électricien, 31. pp. 145-149, March 10; 162-165, March 17; 179-188, March 24, and pp. 198-195, March 31, 1906. Paper read at the École professionnelle supérieure des Postes et des Télégraphes, Jan. 24, 1906.)—The methods usually employed are classified—electromagnetic, electrostatic, electrolytic, rectification of currents, thermal—and a brief description given. A more extended treatment is accorded to the thermal method, and the different forms of hot-wire instrument and bolometer are described, also the Duddell instruments [see Abstract No. 781 (1906)]. L. H. W.

961. *Comparison of Methods for the Measurement of Resistance*. **W. Jaeger**. (Zeitschr. Instrumentenk. 26. pp. 69-84, March, 1906.)—The methods considered are the Thomson double-bridge, the Wheatstone bridge, the method of the differential galvanometer, and the potentiometer. The equations obtained enable the sensitiveness to be calculated for any case and also indicate the most favourable galvanometer resistance. A number of examples are given. F. E. S.

962. *Influence of the Boundary of an Electrostatic Condenser*. **R. Magini**. (Accad. Lincei, Atti, 15. pp. 309-317, March 18, 1906.)—[See Abstract No. 775 (1906).] The discussion is continued, and the relative errors introduced by the space between the plate and the guard ring and by omission of the guard ring are given. S. G. S.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

963. Distillation of Titanium, and the Temperature of the Sun. H. Moissan. (*Comptes Rendus*, 142. pp. 673-677, March 19, 1906.)—Titanium has been distilled in considerable quantity, employing the author's electric furnace and a current of 1,000 amps. at 55 volts. Since most of the elements found on the surface of the earth occur also on the sun, and these have now all been vapourised by means of the electric arc, the temperature of which is about $3,500^{\circ}$, it is concluded that, for the sun to have a solid or liquid nucleus, even allowing for increased pressure, its temperature must lie between the values given by Wilson and Violle, viz., $6,590^{\circ}$ and $2,000-3,000^{\circ}$ respectively, and that it approaches more nearly the latter. W. H. Si.

964. Practical Hints in the Teaching of Physical Chemistry. R. Luther. (*Zeitschr. Elektrochem.* 12. pp. 97-99, Feb. 9, 1906.)—(1) In reading works on thermodynamics confusion often arises because of the different signs used by different writers. The following table gives a summary of these signs, of which those used by Haber are probably the most practical, as they are in agreement with those generally used in thermochemistry:—

		We (exterior world, Reservoir) receive, System (Machine) gives out :			We (exterior world, Reservoir) give out, System (Machine) receive :		
		Energy.	Heat.	Work.	Energy.	Heat.	Work.
Clausius	Mech. Theory of Heat	$-dU$	$-dQ$	$+dW$	$+dU$	$+dQ$	$-dW$
Gibbs	Therm. Stud.	$-d\epsilon$	$-dH$	$+dW$	$+d\epsilon$	$+dH$	$-dW$
Helmholtz	Lectures	$-dU$	$-dQ$	$+dA$	$+dU$	$+dQ$	$-dA$
Maxwell	Theory of Heat	$-dE$	$-W$	$+A$	$+dE$	$+W$	$-A$
van't Hoff	Lois d'equil		$-Q$	$+F$		$+Q$	$-F$
Nernst	Theoret. Chem.	$+U$	$-Q$	$+A$	$-U$	$+Q$	$-A$
Duhem	Traité élément	$-dU$	$+dQ$	$-dZ$	$+dU$	$-dQ$	$+dZ$
Planck	Thermodynamics	$-dU$	$-Q$	$-A$	$+dU$	$+Q$	$+A$
Helm	Math. Chem.	$-dE$	$-dQ$	$-dA$	$+dE$	$+dQ$	$+dA$
v. Oettingen	Therm. Relations	$-dE$	$-dQ$	$-dS$	$+dE$	$+dQ$	$+dS$
Haber	Therm. Gases	$+U$	$+q$	$+A$	$-U$	$-q$	$-A$

(2) In van't Hoff's lectures on theoretical chemistry a deduction of the law of osmotic pressure ($pv = RT$) is given which is independent of the law of Pfeffer-Boyle ($pv = b = \text{const.}$). Very often a beginner does not follow the argument clearly, and the author consequently gives an alternative method, for which the original paper must be consulted. (3) It is pointed out that in van't Hoff's deduction of the reaction isotherm certain processes are assumed to be possible, although they do not seem to be practically realisable. Thus, in the reaction $\text{HCl (gas)} + \text{NH}_3(\text{gas}) = \text{NH}_4\text{Cl (gas)}$, it is assumed that the NH_4Cl vapour can be removed through a semi-permeable partition and then brought to any concentration, without dissociation taking place during this process; while in the reaction chamber itself the reaction velocity is assumed to be very great. The author shows that this is realisable on the assumption

of ideal positive and negative catalysts. If the membrane will not let water vapour pass through it, the presence of this vapour in the reaction chamber will always cause dissociation, while in its absence, *i.e.*, outside the chamber, the NH_4Cl will not dissociate. (4) It is often necessary to state that the quantities x and y are connected in such a way that dy/dx and dx/dy are positive, without stating anything as to the nature of the functions connecting x and y . For such a connection the author proposes the term "Symbasis" (Symbasie), and x and y are said to be "Symbates" (Symbat). If dx/dy and dy/dx are negative, the terms "Antibasis" and "Antibates" are proposed. [See Abstracts Nos. 1185 (1902) and 577 (1904).] T. S. P.

965. *Relationship between Viscosity, Ionic Velocity, and Velocity of Diffusion.* P. Walden. (Zeitschr. Elektrochem. 12. pp. 77-78, Feb. 2, 1906. Polytechnikum, Riga, Dec., 1905.)—It has been shown that for the salt NEt_4I the value of Λ_∞ in different solvents is given as $\Lambda_\infty = 0.700/\eta$, where η is the viscosity of the solvent at the given temperature. Further, the three halogen ions, Cl , Br , I , in spite of their different atomic weights, have practically equal ionic mobilities whatever the solvent in which they are dissolved. The velocities of diffusion of the elements Cl , Br , I , are inversely as the square roots of their molecular weights, but it is now shown that if the product $D \times \sqrt{M}$ is further multiplied by η , the product $D \times \sqrt{M} \times \eta$ is practically constant in all the solvents used, namely, water, carbon disulphide, and benzene. T. M. L.

966. *Limiting Conductivity of Certain Binary Electrolytes in Acetone.* P. Dutoit and A. Levier. (Journ. Chim. Phys. 3. pp. 435-454, 1905. Zeitschr. Elektrochem. 12. pp. 91-92, Feb. 2, 1906.)—The disagreement among the results obtained by various investigators for the conductivity of acetone solutions of salts is due to (1) the use of platinised electrodes, which absorb an appreciable proportion of the dissolved electrolyte; (2) the presence of very small quantities of impurities in the solvent; (3) changes in the solute—for example, the gradual decomposition of ammonium salts when dissolved in acetone. The authors' measurements of the conductivities of salts in acetone solutions extend from the dilution $V=100$ to $V=100,000$. Just as with aqueous solutions, the molecular conductivities increase with the dilution to constant limiting values, which are given in reciprocal Siemens units at 180° in the following table:—

	Li.	Na.	K.	NH_4
Bromide	155	158	155	157.5
Iodide	157	155.5	157.5	157.5
Thiocyanate	—	(169)	170	171
Nitrate	132	—	—	—

These limiting values obey Kohlrausch's law of the independent migration of the ions, but the ratio of the ionic velocities is different from that in water; all the kathions have approximately the same velocity. From the extents of dissociation, which are calculated for various dilutions, it is seen that the dissociation of corresponding salts increases in the series ammonium, lithium, sodium, potassium, and in the series chloride, bromide, thiocyanate, iodide. The dissociation is an additive property of the two ions. T. H. P.

967. *Solution of Platinum and Iridium by Sulphuric Acid.* M. Delépine. (Comptes Rendus, 142. pp. 681-683, March 12, 1906.)—The author investigated the products obtained when platinum was dissolved in concentrated sulphuric

acid [see Abstract No. 425 (1906)]. By very long continued boiling it was found possible to dissolve 2 gm. of Pt per 100 c.cm. of acid. Platinum containing 10 per cent. Ir is much less readily attacked by concentrated sulphuric acid, but the iridium is dissolved with the platinum; the rapidity of solution can be increased by the addition of potassium sulphate. The author concludes that when platinum and iridium are dissolved in sulphuric acid in the presence of ammonium sulphate, the solutions contain the salts of sulphoplatinic and iridosulphuric acids. F. J. B.

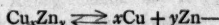
968. *Properties of Electrically-prepared Colloidal Solutions.* E. F. Burton. (Phil. Mag., 11, pp. 425-447, April, 1906.)—The author has carried out measurements on the size of metal particles in solution prepared by the Bredig method, and has obtained the following results: (1) The size of the diameters of the particles of gold, silver, and platinum, in electrically prepared colloidal suspensions, has been found to lie between the limits 2.6×10^{-5} cm. (2) The electro-negative, non-oxidisable metals, gold, silver, and platinum, give solutions in water and ethyl malonate in which the particles are negatively charged. (3) The electro-positive oxidisable metals give solutions in water, methyl alcohol, and ethyl alcohol in which the particles are always positively charged. (4) The velocities of the particles under a known electric force have been determined, and the p.d.'s between the liquid and the particle have been deduced by using the formula $V = 4\pi/K \times \mu v/X$, where V is the contact p.d. between the solid and the liquid, K = specific inductive capacity of the medium, μ = coefficient of viscosity of the liquid, v = the velocity of motion of the particle, and X = electrical potential gradient in the liquid. A. F.

969. *Rotatory Power of Optically-active Substances.* P. Walden. (Zeitschr. Phys. Chem. 55, pp. 1-63, March 20, 1906. Phys.-chem. Laborat. des Polytechnikum, Riga, Aug., 1905.)—The importance of measuring optical rotations for a series of wave-lengths and for a series of temperatures has already been emphasised. The following results are now given: (1) For all homogeneous active materials the ratios a_D/a_r , a_{50}/a_r , a_{55}/a_r , a_{60}/a_r , and $(a_D - a_r)/a_{55}$ are nearly independent of temperature, but the difference $[a]_D - [a]_r$ or $[M]_D - [M]_r$ alters considerably, and may either increase or decrease as the temperature is raised. (2) In homologous series the ratios are practically uniform throughout, though the first member sometimes differs. The difference $[a]_D - [a]_r$ may either remain constant or increase or decrease in the series, the difference $[M]_D - [M]_r$ either remaining constant or tending to a maximum value. (3) The temperature-coefficients a_{100}/a_{30} are independent of the wave-length, and often remain constant throughout a group of compounds. (4) Large rotatory dispersions are usually accompanied by large negative temperature-coefficients, and the refractive dispersion is usually large also for the same colour-interval; large changes in the ratio a_D/a_r are not restricted to substances of high rotatory power, though the latter often give large values for the difference $[a]_D - [a]_r$. (5) In the case of solutions, the dispersion-constants are independent of the concentration of the solution, and in neutral solvents, such as the fatty alcohols, ether, the esters, acetone, carbon disulphide, and the hydrocarbons, the values are usually identical with those for the liquid solute. Abnormal results are, however, frequently observed in solvents, such as chloroform, cinnammic aldehyde, and quinoline, which may interact with the solute, and also in the case of certain solutes, such as methyl malate, even when dissolved in neutral solvents. T. M. L.

970. Cast Iron : Crushing Loads and Microstructure. W. J. Keep. (Amer. Soc. Mech. Engin., Trans. 26. pp. 488-501, 1905.)—The object of this paper is to make more complete the so-called American Society of Mechanical Engineers' series of tests on cast iron. Crushing tests on short cylinders from 19 series of casts show the same sort of variation of strength with silicon and diameter (0.692 per cent. and 1.13 in.) as in transverse and tensile tests [see Abstract No. 1792b (1904)]. Tests show the difference of strength between the edge and centre of round castings, and between corner, side, and centre of rectangular castings. The size of castings has more effect than chemical composition upon the strength. In compression tests of short pieces of considerable section, high results were obtained; the author states that the metal at the outside tends to prevent that at the centre from being crushed. It is recommended that all test bars should be cast 1.13 in. diam. The bending of long bars in compression is largely avoided if they be gripped as for tension, instead of applying the force to flat ends; and the strength, in tension or compression, was shown much better by test-pieces having 8 in. parallel than by short specimens; the former were, of course, also better adapted for measurements of strain. A. Sauveur gives 46 photomicrographs, and a brief report on the structure. There is no marked difference observable between corner, edge, and centre of rectangular castings, in spite of the difference in strength. F. R.

971. Temper-carbon and Graphite in Iron. F. Wüst and C. Geiger. (Stahl u. Eisen, 25. pp. 1184-1189, Oct. 1, 1905.)—Small quantities of temper-carbon are formed, given sufficient time, even at comparatively low temperatures, but the greater portion is freed suddenly at a temperature dependent on the quality of the iron. The speed of cooling has but little effect on the quantity of temper-carbon. This form of carbon is not removed in a gaseous state by the action of pure, dry hydrogen or nitrogen. Graphite may be removed in a gaseous state by carbon dioxide, hydrogen, or iron oxide. [See also Abstract No. 974 (1906).] F. R.

972. Copper-zinc Alloys. O. Sackur, P. Mauz, and A. Siemens. (Ber. Deut. Chem. Gesell. 38. pp. 2186-2196, 1905.)—The curve of the rate of precipitation of copper from its salts shows well-marked breaks at points corresponding with alloys containing 41 to 45 and 60 to 62 per cent. Cu, and the curves of the rate of solution of the alloys in acids give breaks at the same points. The melting-point curve shows breaks at 82.6 per cent. Cu (CuZn_2), at 49.5 per cent. Cu (CuZn), and at 54.6 per cent. Cu (mixed crystals of CuZn and Cu); the two former contain more copper than the formulæ require. It is suggested that a dissociation equilibrium exists in the fused alloy—



the free zinc only disappearing when a certain excess of copper is present. F. R.

973. Silver-zinc Alloys. G. I. Petrenko. (Zeitschr. Anorg. Chem. 43. 4. pp. 847-863, March 3, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Describes freezing-point determinations and examination of microstructure of this series of alloys. The alloys were prepared by adding weighed quantities of Ag to Zn which has been fused in a current of CO_2 . The beginning and end of solidification of the alloys, the

duration of eutectic crystallisation, and the occurrence and duration of changes in the solid alloys were observed, and the results are plotted in a complete temperature-concentration diagram. On this diagram the curve of commencement of crystallisation is divided into six branches; two of the angles between adjacent branches are, however, very small, and the position of the "hidden maxima" was determined by the intersection of the horizontal eutectic lines with the freezing-point curve, and also by the fact that at these points the temperature-interval between beginning and end of solidification attained a minimum value. In the alloys containing from 21.7 to 60 per cent. Zn the microstructure of slowly cooled ingots does not agree with that indicated by the shape of the freezing-point curve, so that changes in the solid alloys were indicated. The alloys from 0 to 21.7 per cent. Zn form homogeneous mixed crystals; from 21.7 to 28.1 per cent. Zn the alloys when chilled from a temperature near the freezing-point, show two constituents, viz., mixed crystals and the compound Ag_3Zn_2 , but when slowly cooled the proportion of mixed crystals is much larger, owing to the decomposition of Ag_3Zn_2 on cooling. From 28.1 to 37.7 per cent. Zn the chilled alloys show homogeneous crystals, but when the alloy containing 28.1 per cent. Zn is slowly cooled it consists of two constituents, although no evolution of heat can be detected. Chilling the alloy from a temperature above 670°C . retains the homogeneous structure, while a chill from below 610° shows the duplex structure, the author taking 640° as the transformation-temperature; this temperature is lowered in alloys richer in Zn until at 37.7 per cent. (AgZn) a marked change-point at 286° is reached. A line joining these two points represents the change $\text{Ag}_3\text{Zn}_2 = 0.6$ saturated mixed crystals + 0.43AgZn . These saturated mixed crystals also undergo a polymorphous change at a lower temperature. The alloys from 37.7 to 47.6 per cent. Zn form mixed crystals of AgZn and Ag_3Zn_2 , but only those with Zn up to 41 per cent. are stable at low temperatures, the others decomposing below 450° into two constituents— Ag_3Zn_2 and mixed crystals of AgZn containing an excess of Zn up to 41 per cent. This whole group also undergoes a polymorphous change between 200° and 300° . Alloys from 47.6 ($=\text{Ag}_3\text{Zn}_2$) to 52.5 per cent. Zn solidify as homogeneous mixed crystals, but those between 52.5 Zn and Ag_3Zn_2 (60 per cent. Zn) solidify either as homogeneous mixed crystals (with lower Zn content) or as a mixture of these mixed crystals with Ag_3Zn_2 , but in both cases fresh Ag_3Zn_2 separates from the mixed crystals below 520° . The remaining alloys form a series of mixed crystals of Zn and Ag_3Zn_2 , but with an interval of mutual insolubility from 82 to 90 per cent. Zn, although two constituents are observed up to 96.5 per cent. Zn. The author regards all the compounds mentioned as well established by the results of this research; the compound Ag_3Zn_2 , particularly possessing a characteristic rose-red oxidation tint.

W. Ros.

974. *Effect of Foreign Elements on Graphite Formation in Iron-Carbon Alloys.* F. Wüst. (Metallurgie, 8. pp. 169-175, March 22, and pp. 201-205, April 8, 1906. Communication from the eisenhüttenmänn. Inst. d. kgl. techn. Hochschule, Aachen.)—Pure cast-iron, specially prepared in a cupola, was melted in crucibles and additions of various foreign bodies were successively made, samples of the alloy being taken at each step by means of a ladle. In this way the effect of tin, sulphur, and phosphorus on the formation of graphite was determined both in the absence of silicon and in the presence of various proportions of that element. The conclusions reached are that tin diminishes the solubility of carbon in iron; in the presence of silicon, the

presence of tin does not affect the formation of graphite, but in the absence of silicon tin appears to facilitate the formation of graphite. In the presence of an excess of carbon the maximum solubility of tin in iron is about 16 per cent. Sulphur is also found to lower the saturation-point of iron for carbon, and this element in all cases counteracts the effect of silicon, sulphur reducing the tendency for graphite formation. Phosphorus, in proportions less than 2.5 per cent, has no effect on the formation of graphite in the absence of silicon; above this proportion an increased amount of phosphorus produces a proportionate increased amount of graphite. In the presence of 0.9 per cent, Si, a proportion of phosphorus exceeding 8 per cent, facilitates graphite formation. The paper contains the quantitative data and analyses upon which these results are based.

W. Ros.

975. *Phenomena of Freezing and Cooling in Iron-Carbon Alloys.* P. Goerens. (Metallurgie, 3, pp. 175-186, March 22, 1906. Communication from the eisenhüttenmänn. Inst. d. kgl. techn. Hochschule, Aachen.)—Reviews the present state of knowledge of these alloys, and describes micrographic research on iron rich in carbon. The disagreement between Roozeboom's explanation and the observed phenomena in the solidification of these alloys is described, and Heyn's suggestion [Abstract No. 430 (1905)] that systems containing iron carbide are in a metastable condition is dealt with. On this view the formation of a martensite-graphite eutectic in cast irons is prevented by rapid cooling, and a martensite-cementite eutectic is formed at a slightly lower temperature, but this metastable system tends to revert to the stable system ferrite-graphite. The author's specimens of chilled pure cast-irons of various compositions confirm this view in a general way, except that the samples rich in carbon could not be chilled rapidly enough to prevent the formation of some graphite. In sections containing small quantities of graphite thus formed, the graphite veins are always found embedded in martensite, and never in contact with either cementite or the eutectic, which the author regards as strongly confirming Heyn's view. The fact that greater rapidity of cooling increases the proportion of cementite to graphite supports the view that carbon is dissolved in molten iron in the form of carbide of iron. The author suggests that cementite tends to decompose at high temperatures, and that the free cementite crystallising from alloys rich in carbon, both before and after the solidification of the eutectic, is thus in a condition to decompose; in the former case the liberated carbon crystallises and rises to the surface, while in the latter it remains embedded in martensite—provided that the rate of cooling is not great enough to suppress the change. The paper is illustrated by ten photomicrographs.

W. Ros.

976. *Alloys of Magnesium with Zinc, Cadmium, Bismuth, and Antimony.* G. Grube. (Zeitschr. Anorg. Chem. 49. 1. pp. 72-92, March 31, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Gives thermal data and photomicrographs of the above four series of alloys, with the temperature-concentration diagrams for each series based upon these observations. The existence of the compounds CdMg , Zn_2Mg , Bi_2Mg , and Sb_2Mg , is deduced from the diagrams and data quoted, but the author claims to have disproved the existence of the compounds CdMg_2 , CdMg_{30} , and ZnMg_2 which Boudouard had described [see Abstract No. 145 (1903)]. The compound Sb_2Mg is remarkable as having a freezing-point at 961°C ., the freezing-points of Sb and Mg being 680° and 650.9° respectively; similarly Bi_2Mg freezes at 715° . The bodies MgCd , Bi_2Mg ,

and Sb_2Mg_3 decompose water and are more readily attacked by moist air than the pure metals, but the reverse is the case as regards the compounds Zn_2Mg and Al_3Mg . W. Ros.

977. Silicides of Nickel. W. Guertler and G. Tammann. (Zeitschr. Anorg. Chem. 49. 1. pp. 98-112, March 31, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Gives a highly complex temperature-concentration diagram, with the data upon which it is based, for details of which the reader must refer to the original paper. Five compounds are described; Ni_3Si and NiSi are formed directly from the fused alloy; a third compound, probably Ni_5Si , is formed by a reaction between crystals of Si and a fluid containing 59 atomic per cent. Si. Two further compounds are formed by reactions taking place between solid crystals; Ni_3Si is formed at $1,125^\circ\text{C}$. from the two series of saturated solid solutions containing 16.0 and 26.5 atomic per cent. Si respectively, while Ni_5Si crystallises from the solid solutions containing from 38.8 to 37.5 atomic per cent. Si. The paper is illustrated by twelve photomicrographs. W. Ros.

978. Colorimetric Affinity-measurements. E. Salm. (Zeitschr. Elektrochem. 12. pp. 99-101, Feb. 9, 1906. From the anorg. Chem. Laborat. d. techn. Hochschule, Aachen.)—The author refers to the use of indicators in measuring the concentration of H^+ or OH^- ions, and points out that it is possible by their means to find the dissociation constants of dibasic acids, even in concentrated solutions. Conductivity measurements are only used in dilute solutions, and then they are complicated by ternary dissociation. The dissociation constants for oxalic, tartaric, fumaric, and camphoric acids are found to be 0.009, 0.0011, 0.0011, and 0.000025 respectively. In the case of the indicators themselves the dissociation constant can be measured as follows: When they are 50 per cent. dissociated the dissociation constant is equal to half the concentration, i.e., equal to the concentration of the H^+ or OH^- ions. In the case of two-colour indicators (methyl orange) 50 per cent. dissociation takes place when they show the transition colour, whereas with one-colour indicators (phenol phthalein) the same percentage dissociation occurs when the colour is exactly half as intense as that of the fully dissociated solution. The author shows how these measurements can be made, and obtains the following constants for 7 different indicators:

INDICATOR-ACIDS.		INDICATOR-BASES.	
	K		K
Methyl orange	4.6×10^{-4}	Cyanin	4.2×10^{-6}
Paranitrophenol	2.3×10^{-7}	Dimethylamidoazo-	
Rosolic acid	1.1×10^{-8}	benzene	1.45×10^{-11}
Alizarin	8.8×10^{-9}		
Phenol phthalein	8.0×10^{-10}		

[See also Abstracts Nos. 1535 and 2355 (1904).] T. S. P.

979. Boiling-points of Saturated Binary Solutions where Interaction Occurs. H. W. Bakhuis Roozeboom. (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 501-506, Dec. 8, 1905. Proc. 8. pp. 538-541, Jan. 25, 1906.)—A continuation of former communication [Abstract No. 878 (1905)]. Examples of possibilities are considered where two and three boiling-points

can occur and also where the solid and solvent boil together. With hydrates of HCl and HBr and solutions of SO_2 in Cl_2 the reaction is in form solid $\rightarrow$ liquid + vapour with rising temperature, the vapour coming from the crystals while the liquid phase increases. BrS_2 , another example, has been investigated by Aten. With ICl_2 it is very marked, and there is at 84°C . a three-phase pressure of 760 mm. This decomposition is further considered, with figures. H. H. F. H.

980. *Molar-weight of the Solvent in Binary Mixtures.* K. Drucker. (Zeitschr. Elektrochem. 11. p. 845, with Discussion, Nov. 24, 1905. Paper read before the 12 Hauptversammlung. d. Deutsch. Bunsen-Gesell. Karlsruhe, June 1-4, 1905.)—By an extension of the theory of van der Waals the surface tension of a binary mixture of liquids can be represented by the expression—

$$\frac{1}{\gamma x} = \frac{1}{\gamma_1} x^2 + \frac{1}{\gamma_2} (1-x)^2 + \frac{1}{\gamma_{12}} (1-x)x,$$

where γ represents the value of the surface tension and the indices 1 and 2 refer to the pure components; γ_{12} is an additional constant for the mixture, and x is the molar fraction of one of the components. The expression gives good results as long as the components of the mixture behave normally (e.g., carbon tetrachloride-chloroform; benzene-ether), but γ_{12} is no longer constant when one component becomes abnormal, e.g., when polymerisation takes place (benzene-acetic acid; carbon tetrachloride-acetic acid). This gives a method of detecting polymerisation or association. In some cases γ_{12} can be made constant by assuming a definite association to have taken place, and thus the extent of the association can be arrived at. For example, in the mixtures acetic acid-benzene or carbon tetrachloride good constants are obtained if the acetic acid is assumed to be associated into double molecules; in mixtures of water with the lower alcohols or fatty acids, the alcohols and acids behave normally while the water is polymerised in the ratio 8:1 or 4:1. T. S. P.

981. *Retrograde Mixture and Separation.* J. v. Zawidzki and M. Centnerszwer. (Ann. d. Physik, 19. 2. pp. 426-481, Feb. 8, 1906.)—From the analogy of binary systems, the phenomena presented by ternary systems consisting of two liquid and one gaseous phase are examined; in this case the critical point of mixing is the highest point of the saturation-curve, but if a third substance is added which goes into solution in both liquids then the critical point of mixing is in general shifted so as no longer to coincide with the highest point of the saturation-curve, and it follows that between these two points the phenomena of retrograde mixture and separation must occur. It further follows that one and the same system appears as a solution of liquid A in liquid B or as a solution of B in A according to the order of operations that results in the system. R. E. B.

982. *Experiment for the Demonstration of Osmosis.* A. Thiel. (Zeitschr. Elektrochem. 12. pp. 229-230, March 23, 1906. Chem. Inst. d. Univ., Münster, Feb. 26, 1906.)—If a drop of a cold saturated solution of a ferrocyanide is allowed to fall on to a dilute solution of copper sulphate and the precipitate formed gently shaken down from the surface, this precipitate first sinks to the bottom where it rapidly grows. During this growth the difference in density between the contents of the precipitate-cell and the outer liquid becomes

continually smaller and finally the cell content is specifically lighter than the copper sulphate solution; the cell then rises like a balloon to the surface of the liquid, where it hangs till the weight of the membrane of the balloon increases sufficiently to cause it to sink once more. D. H. J.

983. *Osmotic Pressures of Alcoholic Solutions.* P. S. Barlow. (Phil. Mag. 11. pp. 595-604, April, 1906.)—Although copper ferrocyanide membranes are permeable to alcohol they were found not to give any osmotic pressure with alcoholic solutions of ferric chloride, lithium chloride and sulphate, shellac, camphor, methyl oxalate, lævulose, or glycerine. A definite pressure was, however, obtained by using guttapercha tissue as the membrane with alcoholic solutions of lithium chloride. The following table shows the osmotic pressure and the electrical conductivity of the solutions:—

Concentration.	Osmotic Pressure.		Relative Conductivity.
	(calc.)	(obs.)	
0.144N	2440 mm.	195	0.0042
0.089N	1660	208	0.0029
0.040N	690	181	0.0016
0.020N	845	76	0.00087

The osmotic pressures fall far below the theoretical values, and the value for the highest concentration actually shows a decrease, lithium chloride being found outside the cell. It is evident that much further work requires to be done before direct measurements of osmotic pressure can be satisfactorily made with non-aqueous solvents. T. M. L.

984. *New Method of determining the Dissociation at High Temperatures.* L. Löwenstein. (Zeitschr. Phys. Chem. 54. pp. 715-726, March 13, 1906. From the Göttinger Dissertation.)—The property of glowing platinum of acting as a semi-permeable membrane with respect to hydrogen is thus utilised. A vacuous platinum vessel is enclosed in a porcelain cylinder with closed ends through which a stream of the gas under research is led, the whole being kept at a high temperature which is thermoelectrically measured, and the pressure of the hydrogen which passes into the platinum vessel is determined by an oil manometer, this pressure being obviously equal to the partial pressure of the dissociated hydrogen in the gas external to the vessel when equilibrium is attained. The necessary corrections for hydrogen diffusing out of the vessel and for the transpiration of the gas into the vessel are discussed. For water vapour the dissociation at 1,432°, 1,510°, 1,590°, 1,695° C. was found to be 0.102, 0.182, 0.354, 0.518 per cent. respectively, and for hydrogen chloride 0.274 per cent. at 1,537° C. R. E. B.

985. *Electrolytic Dissociation.* M. Brillouin. (Annal. Chim. Phys. 7. pp. 289-320, March, 1906.)—Considering that the ions constituting a molecule are not bathed with the solvent, but that the ions or molecules occupy cavities within the solvent, the author works out a theory of electrolytic dissociation on the lines laid down by Nernst and J. J. Thomson. Formulæ are deduced from which the influence of the solvent on the stability of the dissolved molecules is discussed, firstly on the supposition that there is no molecular agitation, and secondly with this thermic agitation taken into account: the case of infinite dilution is also considered, and the general influence of concentration. R. E. B.

986. *The Carbon Cell a Gas Element.* F. Haber and L. Bruner. (Zeitschr. Elektrochem. 12. pp. 78-79, Feb. 2, 1906.)—Using the results obtained by Nernst and v. Wartenberg [Abstracts Nos. 1808 and 1809 (1905)] and by Haber and Moser [Abstract No. 622 (1906)], and assuming that the pressure of the water vapour over the molten mass is identical with the partial pressure of the water vapour in air saturated with moisture at 25°, the authors recalculate the voltages of the carbon cell, Fe—NaOH—C, at various temperatures. At about 400°, the calculated and experimental numbers agree, whilst at low temperatures the former, and at higher temperatures the latter, is slightly the lower. The differences show that at temperatures below 400° the molten mass is of the character of a drying medium. [See also Abstract No. 892 (1905).] T. H. P.

987. *Electrolytic Preparation of Vanadous and Vanadic Salts.* T. F. Rutter. (Zeitschr. Elektrochem. 12. pp. 280-281, March 23, 1906. Phys. chem. Inst., Leipzig, March, 1906.)—If it is desired to stop the reduction of vanadic salts at the trivalent stage, the use of an electrode of small supertension, such as platinised platinum, is to be recommended. Vanadic acid may be easily reduced electrolytically to the divalent stage, especially if electrodes of mercury or lead are employed; in this way the solid double salt $\text{VSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$, may be obtained, in presence of ammonium sulphate. D. H. J.

988. *Electrolytic Reduction of Carbonic Acid.* R. Ehrenfeld. (Ber. Deut. Chem. Gesell. 38. pp. 4138-4143, 1905.)—Ammonium formate is produced by the electrolysis at ordinary temperatures of a solution of commercial ammonium carbonate in one part of ammonium hydroxide of sp. gr. 0.910 and four parts of water, using an apparatus in which the kathode and anode cells are separated by a porous diaphragm, the kathode being of amalgamated zinc, and the anode of platinum-foil, and employing a p.d. of 5-10 volts and a current density of 0.1-0.8 amp. No formate could be detected (a) when the kathode was of Fe, Pt, Cu, Pb, or Ni; (b) when the current density was less than 0.1 amp., nor (c) when the solution was diluted to one-fifth the above concentration. The production of formate is attributed to the presence of NH_4CO_3 anions in the concentrated solution, and not to the carbamate in the commercial carbonate. No formate was yielded by solutions of sodium carbonate, or of carbonate and hydroxide under similar conditions. W. H. St.

989. *Electrolytic Reduction of Molybdic Acid in Acid Solution.* Parts I.-III. A. Chilesotti. (Zeitschr. Elektrochem. 12. pp. 146-166, March 2; 178-183, March 9, and pp. 197-208, March 16, 1906. From the Electrochem. Lab. of the "R. Museo Indust. Ital. di Torino.")—I. The reduction of molybdic acid in hydrochloric, in sulphuric, and in oxalic acid under different conditions of concentration, of current density, of temperature, and of kathode material, was studied with a view to forming new reduction products. *Hydrochloric acid solutions.*—A mercury kathode was first employed, and a porous cell separated the cathodic and anodic spaces. The yield of the product per unit current (the amount of reduction per unit current) was estimated by comparing the amount of copper thrown down in a copper voltameter with the volume of hydrogen liberated at the kathode. Titration of the reduced solution with potassium permanganate showed that the deficit of hydrogen formed was entirely due to reduction of the molybdic acid. With currents of

0.5 to 2 amps. a red solution of the bichloride was always obtained, and the total current yield increased with diminishing current-density and with increasing proportion of molybdic acid. There does not appear to be a simple relation connecting the current yield with the concentration of the hydrochloric acid; there seems rather to be a change in the mechanism of reduction as the concentration of the acid changes. Increase of temperature increases the total yield. With plates of Pt, Pb, and Sn as cathodes, the reduction is in each case stronger than with mercury, being greatest in the case of Pb, which gives a current yield of 100 per cent. Lead and tin reduce a hydrochloric acid solution of molybdic acid without employing an electric current. With platinised Pt the reduction proceeds as far as pentavalent molybdenum, and the yield is better than with smooth Pt. *Sulphuric and oxalic acid solutions.*—The phenomena are different from those in hydrochloric solutions, especially with Pb as cathode; the Pb becomes covered with a layer of lead sulphate, and is thus protected from attack. The phenomena in oxalic acid solution are similar to those in sulphuric acid. The curves to express the current yield are analogous to those found by Löb and Schmitt for the reduction of *m*-nitrotoluene [Abstract No. 3331 1904]. II. The cathodic potential in electrolytically reduced solutions of molybdic acid was determined at different stages, of the reduction in the belief that the existence of a definite reduction product would be disclosed by an abrupt change of potential at the cathode. Platinum was used as cathode, and the p.d. was measured by the compensation method, against a normal calomel electrode. During the whole of the electrolyses the solutions were kept saturated with hydrogen. If the quantities of potassium permanganate used for titrating the solutions are plotted as abscissæ against the e.m.f. of the cathode as ordinates, the curve for a 3.5 per cent. solution of molybdic acid in 9-N hydrochloric acid runs uninterruptedly from -1.025 volt to -0.8 , and then "breaks" to -0.49 volt; the break occurs at a stage of the reduction corresponding to the formation of a pentavalent compound, so that such a compound appears to be the first reduction product. The potential then remains almost constant during further reduction till near the end, when it suddenly changes again from -0.45 to -0.40 volt. There is no indication of the occurrence of tetravalent molybdenum. In 4-N hydrochloric acid the potential is displaced towards the positive side, *i.e.*, the solutions are strongly reducing. Here, again, the first "break" occurs at the pentad stage; the second occurs at a valency of 3.5. This second break disappears in more dilute solutions. III. By Müller and Weber's method [Abstract No. 689 (1904)] the cathodic potential was tested, during the actual electrolytic reduction, against a normal calomel electrode; electrodes of different materials were tried. The results are given graphically as in Part II., and lead to the following conclusions: With Hg and Pt the mechanism of the reduction is the same in character, and differences are only quantitative. With a cathode of platinised Pt, the reduction to MoX_3 is accelerated catalytically to such an extent that the reaction proceeds quantitatively at a much lower potential than in the case of other metals. Lead and tin cathodes also act catalytically.

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REFERENCES.

990. Solubility and Rotatory Power of Carbohydrates and Organic Acids and Bases in Pyridine and other Solvents. J. G. HOLTY. (Journ. Phys. Chém. 9, pp. 764-779, Dec., 1905.)

991. *Apparent Chemical Action at a Distance.* R. E. Liesegang. (Ann. d. Physik, 19, 2. pp. 395-406, Feb. 8, 1906.)—Drops of solution of nitrate of silver laid upon gelatine charged with bromide of potassium form bromide of silver more rapidly in the direction of lines joining these drops, and the circles of AgBr formed by diffusion round the drops are correspondingly distorted. Other experiments of the same character are described. A. D.

992. *Liquid Flowing Crystals.* O. Lehmann. (Ann. d. Physik, 19, 2. pp. 407-415, Feb. 8, 1906.)—Further observations with the substance mentioned in Abstract No. 825 (1906). The question as to whether such bodies can be looked upon as liquid or solid is discussed in a later paper (Deutsch. Phys. Gesell., Verh. 8. 7. pp. 142-145, April 15, 1906.) L. H. W.

993. *Decomposition of Water by Radium.* W. Ramsay. (K. Vet. Akad. Nobelinst., Meddel. 1. pp. 909-911, 1905.)—It has several times been found that when water is decomposed by radium bromide an excess of hydrogen is obtained. One of the probable causes, which also frequently occurs, is oxidation of the grease of stopcocks. The emanation acting on pure water in absence of oxidisable substances gives a gas mixture which consists of H and O in explosive proportions. The action must be due to the α -rays, the β -rays having no action. L. H. W.

994. *A Moissan Electric Furnace.* (Engineering, 81. p. 381, March 23, 1906.)—Describes with illustrations a Moissan type of electric furnace for direct or alternating currents up to 1,000 amperes at 50-150 volts. It is made by Marryat and Place, of London, and is used at the National Physical Laboratory. W. W. H. G.

995. *The Physics of Ore Flotation.* J. Swinburne and G. Rudorf. (Faraday Soc., Trans. 1. pp. 336-344, Feb., 1906. Chem. News, 92. pp. 288-289, Dec. 22, and pp. 295-297, Dec. 29, 1905.)—The authors commence the paper with the following paragraphs, which concisely summarise the contents. Argument.—Theory that bells of sulphuretted hydrogen carry up the particles of sulphide is invalid.—No hydrogen sulphide is evolved.—Adhesion between solid and liquid.—Surface tension of liquid.—Their joint action.—Cohesion of liquids.—Sometimes enormous.—Air films and adhesion.—Rise of temperature reduces surface tension, which becomes zero at critical-point.—Rise of temperature reduces adhesion probably to zero at boiling-point.—Raising temperature to near boiling-point thus necessary for flotation.—Effect of air films.—Presence of carbonates necessary.—The authors deal with these points, giving calculations, experimental data, and theories. J. L. F. V.

996. *Ferro-molybdenum Compounds.* E. Vigouroux. (Comptes Rendus, 142. pp. 889-891, April 9, and pp. 928-930, April 17, 1906.)—By direct union of iron and molybdenum, either in the nascent or in the free state, a series of definite crystalline compounds have been obtained corresponding to the formulæ Fe_2Mo , Fe_3Mo_2 , FeMo , FeMo_2 . They are grey, non-magnetic bodies, insoluble in HCl, but completely soluble in HNO_3 , concentrated or dilute. All indefinite ferro-molybdenum alloys are found to be magnetic. W. H. St.

997. *Aluminium-Nickel-Titanium Alloy.* (D.R.-P. 154,485. Zeitschr. Instrumentenk., Beib. 22. pp. 219-220, Nov. 15, 1905. Abstract.)—According to this patent of the Zentralstelle für Wissenschaftlich-technische Untersuchungen, of Neubabelsberg, Ni-Al alloys do not suffer from the usual tendency to the formation of blow-holes and pores when a small amount of titanium is present (not over 2 per cent.). The cause of this action is apparently to be attributed to the formation of a Ti-Al alloy having the formula TiAl_4 , which—under metallographic examination appearing as thin, characteristic rods—separates out from the still-fluid Al-Ni groundwork, forming a starting-point for the solidification of the latter, and leading to a close, homogeneous casting metal. L. H. W.

998. *Antimony-Tin Alloys.* **F. E. Gallagher.** (Journ. Phys. Chem. 10, pp. 93-98, Feb., 1906.)—The author has determined the temperature-concentration diagram for Sb-Sn alloys above 200° C. He concludes that these metals form four series of solid solutions, and no compounds. The β crystals are unstable below 313°. In most other respects his results confirm those of previous workers; the reasons for any differences were studied and are discussed. **F. R.**

999. *Silver Oxide and Silver Suboxide.* **G. N. Lewis.** (Amer. Chem. Soc., Journ. 28, pp. 139-158, Feb., 1906. Contribution from the Research Lab. of Phys. Chem. of the Massachusetts Inst. of Technology, No. 8.)—The author has determined the dissociation pressure of silver oxide at 302°, 325°, and 445° and found it to be 20.5, 32, and 207 atmos. respectively. (Silver suboxide was not formed.) From the change of equilibrium with the temperature, the heat of formation of silver oxide is calculated to be 64 centuple calories. The decomposition pressure of silver oxide at 25° is calculated to be 5×10^{-4} atmo. **A. F.**

1000. *System: Bromine and Iodine.* **P. C. E. M. Terwogt.** (Zeitschr. Anorg. Chem. 47, 2, pp. 203-243, Oct. 20, 1905. Extract from Dissertation, Amsterdam, 1904.)—For mixtures of iodine and bromine the author has investigated the equilibria which exist between the solid, liquid and vapour phases by determining (1) the liquidus and solidus curves; (2) the composition of the liquid and solid phases at different temperatures; (3) the boiling-point curves; (4) the vapour-pressure curves. Furthermore, the densities of different solid-liquid mixtures have been determined at various temperatures. The results point to the existence of a molecule of composition IBr in the liquid and gaseous phases, the dissociation being much greater in the gaseous than in the liquid phase. The liquidus and solidus curves not only coincide for pure iodine and pure bromine, but also for the composition represented by IBr. At all intermediate compositions the curves seem to represent two unbroken series of mixed crystals, one from 0-50 atoms per cent. iodine, and the other from 50-100 atoms per cent. iodine. From the form of the curves the substance of composition IBr cannot be a mixed crystal. **T. S. P.**

1001. *Equilibria between Perchloric Acid and Water.* **H. J. van Wyk.** (Zeitschr. Anorg. Chem. 48, 1, pp. 1-52, Dec. 2, 1905. Universitätslaborat. Amsterdam, Sept., 1905.)—The author has made a complete study of the freezing-point curve of the system perchloric acid—water; the boiling-points of solutions of perchloric acid in water were also studied. Perchloric acid itself, even under low pressures, does not boil constantly like a pure liquid. The densities and viscosity of mixtures of perchloric acid and water were determined. **A. F.**

1002. *The System: Sulphur-Chlorine.* **A. H. W. Aten.** (Zeitschr. Phys. Chem. 54, pp. 55-97, Dec. 22, 1905. Chem. Laborat. d. Univ., Amsterdam, July, 1905.)—In continuance of previous work [Abstract No. 1455 (1904)] the author has investigated the vapour-pressure curves of the above system. He finds therefrom, that at 0° the compound SCl_2 is present and partially dissociated. From the course of the boiling-point curves, it was found that S_2Cl_2 is dissociated to a small extent at its boiling-point whereby the existence of SCl_2 is confirmed. There are also evidences of the presence of SCl_4 . It was found that the formation of SCl_2 is catalytically accelerated by SCl_4 . The melting-point phenomena were also studied. **A. F.**

1003. *Equilibrium between Silver Amalgams and a Solution containing Silver and Mercury Nitrates.* **W. Reinders.** (Zeitschr. Phys. Chem. 54, pp. 609-627, Feb. 13, 1906.)—From a study of the equilibrium existing between silver and mercury and solutions containing the mixed nitrates in all proportions, it is found that mercury and silver form two compounds, Ag_2Hg_3 and Ag_7Hg_8 , and probably also Ag_3Hg . No compound of the formula AgHg is found. **T. H. P.**